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WILD ANIMAL LIFE AS A PRODUCT AND AS A NECESSITY OF NATIONAL FORESTS[1]

BY JOSEPH GRINNELL,

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The animal life of our National Forest areas is, I believe, worthy of serious consideration on the part of each and every person who feels concern for both the present and the future welfare of our country. In any proper catalog of the useful animals in forest regions, I would include the lesser bird life of large variety embracing both insectivorous and seed-eating kinds; the game animals (as grouse, quail, rabbits and deer); the fur-bearing animals (skunks, coyotes, foxes, marten, fisher); the rodents, ground-inhabiting as well as tree-inhabiting (pocket gophers, marmots, chipmunks, flying squirrels); the fishes and frogs of the streams; and, often of great importance indirectly if not directly, the multifarious insect life.

The values pertaining to the original, full complement of animal life are widely diversified. There is the service of various animals in many ways directly to the welfare of the forest trees, as I will try to set forth in some detail presently. There is the commercially important annual output of furs. There is the meat value of game animals, more especially of deer. There is the dollars-and-cents income to rural communities and transportation companies from the annual immigration of hunters and vacationists. There is the recreational use of the wild life in National Forests to people at large, a use now, happily, being encouraged in many effective ways by our foresters.

[1]Read before California Section of Society of American Foresters, Hilgard Hall, University of California, April 10, 1924.

The service of National Forests to the vacationist involves his thorough-going physical, mental, and esthetic recreation. In performing this service the animal life existing within the National Forests should constitute, I believe, at least next after the trees themselves, the most valuable single asset. For the best recreative forces in nature are those which serve most quickly to call into play latent and seldom used faculties of mind and body—those faculties whose exercise tends to restore the normal balance to the human mechanism that special or artificial conditions of living have upset. Foremost among these recreative elements in the forest are the living things that move in sprightly fashion and utter sounds, exhibit color, and change in form, and by these qualities attract and fix the person's interest. To enthusiastically seek acquaintance with these primal objects of interest is, of course, to know the thrill of vigorous muscular activity; but better yet, to bring into use the generally neglected senses of far-seeing and far-hearing, to invite an esthetic appeal of the highest type, and an intellectual stimulus of infinite resource. It is the animal life that can confer these benefits in, perhaps, largest measure.

I wish now to point to the far-reaching inter-relation of all the living things in the forests. There can be no snappy and full-fleshed trout in the brook without adequate insect life to feed upon. There can be no insects without suitable plant food for *their* subsistence. There can be no singing finches and grosbeaks in the glades without seeds and fruits for *them* to feed upon. There can be no warblers in the tree-tops unless there be an unfailing supply of "bugs." There can be no foxes and weasels to thrill us momentarily when we come upon them, without rodents for them to feed upon. There can be no gay and frisky chipmunks without seeds to feed upon. There can be no seeds unless the annual crop of vegetation has been left to mature.

Not only does the forest area afford the means of existence for a great number of animals, with reference to both species and individuals, but, I am led to believe, the forest trees themselves depend, for their maintenance in the condition in which we observe them in this age of the world, upon the activities, severally and combined, of the animals which inhabit them now, and which have inhabited them in the past. The pocket gophers, the ground squirrels, the moles and the badgers are natural cultivators of the soil. It is in considerable degree the result of their presence during long series of years that the ground has been rendered suitable for the growth of not only grasses and herbs but even of shrubs and trees, particularly in the seedling stages of these woody

plants. All sorts of vegetable life contribute ultimately to soil accretion by reason of their dead remains being torn to pieces by animals, and the fragments scattered by animals, and these then overlaid by earth brought up by animals from deeper layers. The animals which feature importantly in this comminution are the woodpeckers, chickadees and nuthatches, the tree squirrels, chipmunks and porcupines, the burrowing beetles, termites and ants, and then the burrowing and burying mammals which I have just previously referred to. This process of incorporating organic materials into the soil, accomplished in large measure by animals, is, I cannot help but believe, of both immediate and lasting importance to the welfare of the forests.

I do not make claim that *all* animal life is *all* the time directly beneficial to the forests. Many insects feed upon the living foliage of the trees, and others tunnel under the bark where they feed upon the growing layers of the wood; in so doing such insects shorten the lives of the individual trees, or even sometimes kill them outright within a single season. The sudden over-abundance of any destructive type of insect brings serious injury to the forests. But a generally effective counteractant is at hand.

Observation has led us to recognize in certain groups of birds, as well as in certain mammals such as bats, natural checks to the undue increase of tree-destroying insects. Insects of one category inhabit the bark of a tree or the layer of wood directly beneath; others pursue their existence among the smaller twigs; still others live amid the foliage of the tree. In each of these cases the substance of the tree is levied upon for food by the insect and if levied upon too freely the tree suffers beyond its powers of recuperation. But, as counteracting factors, we find corresponding categories of *birds,* each especially equipped to levy upon one of these categories of insects. The woodpeckers search the trunks and larger limbs, the chickadees comb the twiggery, the kinglets and warblers go over the foliage leaf by leaf. The great value of any one type of bird to the tree comes when the corresponding type of harmful insect begins to multiply abnormally. For birds are well known to turn from their ordinary food sources and concentrate upon the one suddenly offering in more generous measure. Their shift of attention constitutes a sort of automatic control.

Now, it seems to me as though it is to the interest of the forest at large that a reserve nucleus of birds be *maintained,* as a form of insurance, to be ready at critical periods, against potential insect outbreaks. Incursions of new insects from neighboring areas as well as sudden

eruptions of native species have probably occurred again and again from time immemorial. In other words, as I see the situation, it is an advantage to the forest that a continual moderate supply of insects of the various potentially harmful types be maintained by it for the support of a standing army of insectivorous birds, which army will turn its attention to whatever insect plague begins suddenly to manifest itself, whether this plague be of endemic or of foreign origin. It seems plain to me, reasoning along such lines as the above, that a nice interdependence exists, an adjustment, by which the insect and the bird, the bird and the tree, the tree and the insect, are all, under average circumstances, mutually beneficial in the sense that in each case the *species* is enabled to persist.

I could go on, almost indefinitely, pointing out ways in which interdependence is manifest. I will cite just one more specific case. The White-headed Woodpecker, of the yellow pine and silver fir belts, is a species that does practically all of its foraging on trees which are living, gathering from them a variety of bark-inhabiting insects. But the White-headed Woodpecker lacks an effective equipment for digging into hard wood. It must have dead and decaying tree trunks in which to excavate its nesting holes. If by any means the standing *dead* trees in the forests were all removed at one time, the White-headed Woodpecker could not continue to exist past the present generation, because no broods could be reared according to the inherent habits and structural limitations of the species. A factor in the well-being of the forests is thus the continual presence of *some* dead and decaying trees. Without them, within a woodpecker generation the forests would be deprived of the beneficent presence of this particular species of bird.

After a good deal of this sort of study, contemplating the modes of life of various kinds of vertebrate animals, we naturalists have come to recognize three factors of the environment which seem essential to the successful existence of each and every species. These factors are:

(1) Presence of safe breeding places, adapted to the special needs of the animal; in other words, dependent as to kind upon the inherent powers of defense and concealment in the species concerned.

(2) Presence of places of temporary refuge for individuals during day time or night time or while foraging, when hard-pressed by predatory enemies, again correlated with the inherent powers of defense and concealment of the species involved.

(3) Food supply afforded, in proper kind and adequate quantity,

with regard, of course, to the inherent structural powers in the animal concerned to make it available.

Now, all three of these factors have to be met simultaneously in the case of each and every kind of animal in order that that kind be present in a locality. When present in our National Forests as regards any one species, say a particularly desirable one, that species fills the territory to capacity, as gauged by the *amount* of food and of shelter available there. The geometric ratio of reproduction of the animal *insures* this under normally favorable circumstances.

I have pointed out directly, or have implied, values, both recreational and more tangibly economic, of animal life in National Forest areas. I now ask whether, in our forests generally, conditions in respect to abundance of animal life are ideal. My own observation, extending rather widely throughout California during the past 25 years, has led me to the conviction that conditions are alarmingly short of the ideal—more specifically, that there has been a steady diminution in our wild animal assets, in many places, indeed, approaching near to total exhaustion. The adverse factors to account for this unfortunate state of affairs, which are likely first to come to the reader's mind, are: over-hunting and over-fishing; and repeated devastation of forest lands by fire. The last factor I will not attempt to discuss at all. It is a separate big question, and it already claims the prime attention of professional foresters.

With regard to excessive hunting and fishing, we do have, of course, an important factor to deal with. I would believe, however, that the white man's unthinking practice of hunting to the limit for food or for sport—in other words the "hogging" of game (and fish) was the prime, or even the only, cause of the diminution or disappearance of game species such as the mountain quail and Sierra grouse, *if it were not that* I observe a similar diminution in *other* birds and mammals which man has never considered game and has never killed to any appreciable degree. *The* cause of depletion of our animal life at large must therefore lie in some factor common to both game and non-game animals; and, in accordance with the general laws set forth in preceding paragraphs, that factor is none other than *reduced subsistence*—lessened food and shelter available to them.

And what *has* caused this widespread lessening of the food-supply and the shelter? *The* deleterious agent that I plainly see to have operated in the recent past, and to be operating right along, is com-

prised in the live stock run on the wild untilled land by man: sheep, goats, cattle and hogs.

No amount of game laws, the perfect control of hunting and fishing, will bring an improvement in output of wild animal life *unless* there be provision of adequate food and shelter for it. If the food be appropriated by live stock, and the natural cover be destroyed by browsing or trampling by live stock, the output of wild life will inevitably continue small; not only that, but it will shrink down even to the vanishing point in the cases of many sensitive species. We will then have lost, beyond retrieving, many animals of positive use in the maintenance of the healthy life of forest trees, many animals of marked esthetic and recreational value, and many animals of direct commercial value.

You cannot make two things of the same biological predilections occupy the same space at the same time. There cannot, in my understanding of the situation, anywhere or ever be a so-called "maximum" output of live stock and an ideally abundant output of wild animal life from the same area at the same time. Sheep and cattle, goats and hogs, are animals which introduce entirely new features into the organic inter-relations in forests. Wild herbivores cannot compete with domestic herbivores on anywhere near equal footing. Live stock is taken into the lowlands in the fall after having stripped the forage from the mountains, and the native herbivores are left there to do the best they can with the meagre residue at the severest season of the year. They starve, and their reproductive vigor is reduced. It is the food supply available at the season of *least* supply that determines the *maximum* amount of resident animal life that can exist. Take off most of, or all of, the grass, herbs and browse during the summer and there will be little or no crop of hay or seeds or fruits to carry the native wild animals through the winter and spring before the next crops grow.

When I traverse our mountains in late summer and autumn, I cannot but deplore the trampled streamsides, the mere stubs of browsed-down willows, the denuded mountain meadows, the dust-wallows which once were lush-grown seepages or actual springs. For in these conditions I account for the scarcity of fish life in the scanty streams, for the want of bird-life everywhere. Let it be recalled here that many of the best insect-foraging birds of the coniferous forests require stream-side vegetation for subsistence (food or, indirectly, shelter) at least part of their time.

Sheep and cattle are man's own invention, in the sense that these

animals have been ingeniously selected to become effective machines to convert vegetable matter into meat, hides, wool, and associated products. With certain breeds this "improvement" has been in the direction of making them more and more *thorough* grazers. As the herds go over the open ranges season after season, they leave less and less living vegetation, and less and less vegetational debris in their wake. The sheep and cattle are herded out of the forests after consuming great quantities of organic matter—a continual drain, with little return of benefit. There looks to me to be progressive organic impoverishment of the territory, as the years go by. Soil fertility is being reduced toward the vanishing point.

The burrowing rodents, the natural cultivators of the soil, make the ground suitable for the growth of herbs and also for young trees; but burrowing rodents cannot exist without adequate food supply, afforded chiefly by underground roots and stems and above-ground stalks and seeds of annual or perennial plants. Removal of the latter by sheep and cattle means, therefore, a lessening rate of natural cultivation (the need of which is intensified by the tramping and packing of the soil by the heavy bodied beasts) and this, in time, cannot but reduce forest and other plant production. We must keep constantly in view a long-time program. This is being emphasized most fittingly in the National Forest policy as controlling the manner of harvesting lumber. The principle applies quite as fittingly to the grazing question as affecting the conservation of forest animals. We must never leave out of consideration the welfare of our children and *their* children, a truth that cannot be dulled by repetition. Immediate profits are of little import in the long run. The permanency of the water supply from the mountain masses to the irrigable valleys below is without doubt closely dependent upon the preservation of adequate vegetational cover. Will the lapse of a few hundred years find California in the condition of a Mesopotamian desert, with a scanty low-grade human population, or will it be a permanently fertile, prosperous country, supporting the highest type of civilization?

And now of cheerfully optimistic portent, I can see absolutely nothing in the modern policy of utilizing the forests on the permanent production plan (if with grazing greatly reduced or, better, left out altogether) that is inimical to the maintenance of a maximum, though naturally variable, output of wild animal products. The old, mature forest, ready to harvest by the lumberman, is, indeed, the stage of forest growth that is most barren of animal life. Cutting such timber

by modern, unwasteful methods means prompt increase in the aggregate of animal life in the area cut over. There is no question of this. Of course, there are some specialized dwellers in heavy, old forests which will likely be reduced or even disappear. But a mixed forest of young and older trees, with some openings and much low growth, gives a much greater crop of animals in general than an old, close-growing, densely shaded forest, with its nearly bare floor. A regularly cut-over forest area is the best thing for maximum realization upon its animal assets, including insectivorous bird-life, game, fur and fish.

It is the native, endemic complement of animal life that we should encourage by every consistent means. I would earnestly warn against any policy of introducing non-native animals, of any sort whatsoever. The ever recurring suggestion of the uninformed sportsman who sees the reduction in our game animals, that we bring in and plant foreign species, is fraught with many grave dangers. Without reciting these dangers here, I will declare my personal belief that there are no finer species in the world, from either the forester's, the sportsman's, or the vacationist's standpoint, than our own native species. Let us strive to make conditions favorable for these proven desirables—by conserving the natural food and shelter for them, and by keeping out alien competitors, thus insuring their maximum service to us.

In a very real sense, the summer camper, whom we encourage to come to our forests and profit by the recreation afforded there, is an alien animal interloper. He is obviously and deplorably destructive. The forestry man has to study the natural history of *this* migratory animal and curb *its* destructive tendencies. The method to follow with the intelligent and reasoning type of man, is, of course, to train him, by instruction and suggestion, to proper behavior. I believe the public *is* rapidly being educated along these lines. The type of man that it proves impossible to instruct in the proper way to behave in National Forests must be forbidden the privilege of using them. A few cases of outright expulsion of offensive campers would doubtless be helpful, if well advertised. The destruction of plant and animal life by people, even with the greatly increasing visitation which promises, will probably be less and less as time goes by.

Returning once more to the grazing question, I believe here lies a way to bring back the wild animal life as a product of and necessity for National Forest areas. If I am right in my interpretations, continuous and intensive grazing and browsing by domestic stock on wild, uncultivated lands means progressive depletion of our wild-life re-

sources. This extends to the forest trees themselves which, I think I have shown, depend upon normally plentiful animal life for their own successful growth. Especially in those parts of the National Forest areas where the native complement of animal life looms large as a recreational asset, the live stock should be kept out altogether; in other words *any* grazing there is "overgrazing." On the other hand, it is granted that some open parts of the National Forest areas, where tree growth is naturally inferior, may best be devoted chiefly or exclusively to grazing, that is, to grazing carried on with such moderation as will postpone indefinitely the complete exhaustion of the land. But on those areas we must be content with small or no return of other organic products.

I would not, of course, urge drastic and immediate prohibition of grazing throughout our National Forests. Such arbitrary action would bring widespread hardship to stockmen and others whose vocational interests are bound up in the present grazing system. But I do want to see general and steady reduction of grazing on our National Forests, conducted properly so as to allow for gradual economic readjustment, well under way. Such process of reduction, once begun, should be continued without interruption toward whatever degree, even complete abandonment, as is adjudged by impartial biological opinion necessary in the true interests of the future welfare of our country. We pride ourselves upon the advanced state of our "civilization." The most thoroughgoing definition of a high civilization I know of is "the power to build most firmly for the future"[2]—the willingness to put the future welfare of the race before the present interests of groups of individuals.

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[2]E. M. East: Mankind at the Crossroads (Scribner's, 1924), p. 147.

THE GRAZING OF CATTLE AND HORSES IN PINE* PLANTATIONS

By Paul W. Stickel and Ralph C. Hawley

INTRODUCTION TO THE PROBLEM

Ever since the establishment of the National Forests, the relation of grazing to forestry has been a debatable question. It has been only recently, that definite conclusions have been reached as to this relationship. Through investigations, it has been shown that grazing from the viewpoint of the forester may be harmful and may also be beneficial; harmful when permitted without restrictions on areas where trees are still in the seedling and early sapling stages; but beneficial when used under a definite system of range management as a factor in reducing the fire hazard. In the East, this problem has also been one of importance, but to a lesser degree than in the West. Generally, it has been the opinion of foresters in the Northeast, that grazing under most conditions should not be permitted in young pine and hardwood stands. In New England, where the idle lands are being reforested with pine plantations, the withdrawal of such lands from grazing use will tend in the future to bring this relationship between grazing and forestry much more to the front than in the past. As yet, little has been done in this region in an investigative way to demonstrate the opinion held by so many that under most conditions grazing is harmful in young stands of pine and hardwoods. It is hoped that this paper may throw some light upon this question, as related to Southern New England.

Many thousands of acres of idle lands throughout Southern New England, and the immediate regions south and west of this area have been planted to conifers. A majority of such planted areas consist of lands from which the original forest have been removed, used for a time for raising agricultural crops, and then left idle.

Such is the case with most of the 1,900 acres of plantations made under the direction of the Yale School of Forestry on lands of the New Haven Water Company. On certain of these plantations, the grazing of cattle and horses has been permitted. The length of time during which grazing has been going on in the plantations varies; in some cases the animals have been allowed in the planted areas since the establishment of the plantations, while in others, the animals have only grazed for the past year or more. Of more importance than the small money

*Contribution No. 25 of the Yale School of Forestry.

returns derived from such a practice, the chief reason for permitting grazing was the hope of reducing the fire hazard through the removal of the grass cover by the animals, thus lowering the amount of dry vegetation left at the end of the growing season. How successful this practice has been in accomplishing this last purpose will be discussed later.

Recently, attention was called to the seemingly large amount of damage caused by grazing in certain of these grazed plantations. An investigation was conducted in plantations where grazing has been permitted with the aim of reaching conclusions as to the damage caused by the animals so as to determine whether such damage is severe enough to warrant the exclusion of the stock. Such a study should bring out any of the advantageous features of this practice.

THE PLANTATIONS STUDIED

With few exceptions, all of the areas in which grazing had been allowed are located on lands once used for agricultural purposes and then abandoned. Under such conditions, the majority of these plantations are on the better upland sites, where the soil and the drainage conditions are good, and where the soil supports an abundance of grasses and other forage plants. The plantations examined vary in size from 4.1 acres as the smallest, to 32.2 acres as the largest; the age of the plantations vary from one set out this spring (1924) as the youngest, to one 14 years old as the oldest. The length of the grazing season is in some cases year-long, but in the majority of cases extends from March to October.

With the exception of two of the plantations, all are free from any overwood. On these two plantations, there still remains a scattered open stand of red cedar and some hardwoods. However, in most cases the plantations have been invaded by such hardwoods as gray and black birch, bird cherry and alder. As yet none of these invading hardwoods are competing with the pines, though in many cases they are of the same height.

The two species used in planting are red and white pine planted 6 by 6 feet apart; some of the plantations are pure, while others are mixed. All but the two oldest plantations as yet have not reached an age where the trees have closed together. The areas still support an excellent forage crop, likewise permitting the easy passage of the animals through all parts of the plantations. In the two oldest plantations, the trees have now closed together with the lower branches interlaced. This restricts the grazing in such plantations to open paths since the animals

will not force their way through the closed stand. These latter areas no longer support any grass cover except where openings in the stands occur.

METHOD OF INVESTIGATION AND TYPES OF INJURY

In each of the areas which have been subjected to grazing, an extensive examination was first made of the area with the aim of finding out where damage caused by the animals seemed concentrated. This was done so as to make possible an estimate of the total area of damage in relation to the total area of the plantation. On such areas of concentrated injury, an intensive examination was made of all the trees; the species, total height, character of damage and possible cause were all noted for each tree. A sample of the field data for one of these areas is included further on in this paper.

Injury to the pines by the animals was found to fall into the following general classes:

a. Bark injury—this type of injury may be caused by rubbing, biting or scraping off the bark by the hoofs of the animals. Rubbing and biting was found generally to be confined to the upper two thirds of the tree, while scraping by hoofs was restricted to the base.

b. Branch injury—this type of damage consisted either in breakage caused by the pressure of the animals against the branches, or biting off the leaders or side branches.

c. Foliage injury—this type of injury is caused by biting or pulling away the needles.

d. Breaking or bending of the tree at the base.

There appears to be a difference between the damage caused by cattle and that caused by horses. This difference can be distinguished in the field due to the fact that horses are biting animals, while cattle are not. Thus, when leaders are bitten away by horses, a clean scar with a smooth surface is left, while similar damage done by cattle is more of a tearing or ripping process. Any damage such as bitten leaders or side branches is readily detected since such wounds soon become covered over with resin which upon hardening leaves a white scar.

Bark injury, especially when found at the base of the trees appears to be caused mostly by horses. Such a type of injury to the base of the trees cannot be confused with mice or ant injury. The animals in trampling against the base of the tree shear off the bark completely, thus

exposing the wood beneath. Such a wound is jagged in appearance with shreds of bark adhering to the base and sides of the scar.

Foliage injury as caused by the two classes of stock may also be separated. Leaders and branches from which the needles have been stripped by cattle appear as though the needles had been plucked. Where horses have cropped the foliage, the needles are bitten away, in many cases leaving behind parts of the needle bundles adhering to the branches.

Several opportunities were had to observe cattle as they grazed in the plantations. In no case were any of the animals found to be cropping the foliage of the pines. Intermixed with some of the conifers, were single and scattered groups of gray and black birch and bird cherry, whose leaves were just unfolding. The cattle seemed to be especially partial to the leaves of these hardwoods and would go to great pains to strip the leaves from these trees. By taking the tall leaders of the hardwoods as high up as the animal could reach between the jaws, a cow would bend the leader downward and allow the natural spring of the hardwood leaders to draw the branch through its jaws thus stripping away the leaves. Although in many cases these hardwood shoots were touching the pines, a careful examination made after the cattle had finished stripping the leaves from the hardwoods, failed to show any injury to the foliage of the pines. Several times cattle were found to be lying down in the plantations where the pines were 3 feet and less in height, yet none of the stock were found to be lying on or against the pines.

THE DATA COLLECTED

In the following pages is a summary of the data collected in the various grazed plantations. With an aim towards the conservation of space, only one complete record of field notes is given; the data on the rest of the plantations has been summarized. In analyzing the probable degree of damage done by the animals, the chief stress has been placed upon possible future reduction in density of stocking. With this aim in view of possible loss in numbers or reduction in the quality of the final product as brought about by grazing injuries, the following classification of the degree of injury has been made:

a. Slight damage—pulling and biting of needles, rubbing against bark, and breakage of lower branches.
b. Moderate injury—scraping bark at base of tree and bending over of tree.

c. Severe injury—bitten leaders and upper branches, severe breakage of upper branches, breakage of tree at base, and death of trees caused by grazing.

In relating the areas severely injured by stock to the entire area of the plantation in which such concentrated injury was found, it has been assumed that only the trees which have suffered severe damage will cause any reduction of stocking. This assumption is based primarily upon the idea that trees under this class of degree of injury are the ones in which there may be a slowing down in the height growth, thus causing a reduction in numbers of the trees, or a loss in the quality of the final product. As a matter of fact, part of the trees severely injured will recover and are likely to be present in the mature stand.

Furthermore in calculating the original number of trees on the areas investigated as to concentrated damage, it was estimated that there had been a loss of 20% of the original number of trees due to other causes than grazing. This figure is based upon actual studies made in similar plantations where there had been no grazing.

The summarized data on each of the following plantations consist of two parts. Under the heading of "Analysis of trees on damaged areas" there is given the total number of trees on the damaged area, the percentages of uninjured and injured trees by species, and percentages and numbers of trees injured by the two classes of stock when both cattle and horses have caused injury. In this part of the summary no attempt has been made to coordinate these trees on the damaged areas or the area of this damaged area to the entire plantation.

Under the summary headed by "Analysis of degree of damage" an attempt has been made to separate the classes of degree of damage and in turn relate this to the area of the damaged part of the plantation and also to the area of the plantation as a whole. Following this last summary is an estimate of the future loss in stocking or reduction in quality as caused by present grazing injuries.

SUMMARY OF PLANTATIONS INVESTIGATED

PLANTATION A

The total area of this plantation, 9.2 acres, is planted with 3-year-old red and white pine transplants set in 1917. Age of plantation at time of examination is 7 years. Stocking is very complete with the exception of a wet area which is open. Average height of the trees is 5 feet. Forage crop is good due to the fact that the trees as yet have not closed together. Cattle only have been permitted to graze this area with

7 head in 1922 and 1923. The area where grazing injuries are concentrated is approximately 150 feet long by 30 feet wide. This area of heaviest grazing damage is located centrally along an opening in the fence through which the cattle gain entrance to the plantation. At one side of the opening in the fence is a salting trough. The area of concentrated injury is .103 acres in extent or 1.12 percent of the entire area of the plantation.

DATA SHEET—PLANTATION A

Tree Number	Species	Height Feet	Nature of Injury	Injured By
1	White Pine	5	Top needles pulled away	Cattle
2	White Pine	6	Top needles pulled away	Cattle
3	White Pine	6	Top needles pulled away and bark rubbed on side	Cattle
4	White Pine	3.5	Leader broken off	Cattle
5	Red Pine	6.5	Side branch broken	Cattle
6	White Pine	2	Tree bent over, branches broken and trampled	Cattle
7	White Pine	2.5	Tree completely killed	Cattle
8	White Pine	3	Leader killed back	Cattle
9	Red Pine	2	Tree bent over and trampled	Cattle
10	Red Pine	2	Tree bent over by trampling	Cattle
11	Red Pine	3.5	Lower side branches broken	Cattle
12	Red Pine	3.5	Lower side branches broken	Cattle
13	Red Pine	3.5	Lower side branches broken	Cattle
14	White Pine	2	Leader and side branches broken	Cattle
15	Red Pine	4	Lower side branches broken	Cattle
16	White Pine	4	Lower side branches broken	Cattle
17	White Pine	5.5	Lower side branches broken	Cattle

ANALYSIS OF TREES ON DAMAGED AREA—PLANTATION A

Total Number of Trees on Area Examined	112
Uninjured Trees	95
White Pine	30
Red Pine	65
Injured Trees	16
White Pine	9
Red Pine	7
Dead Trees	1
White Pine	1
Total Percent of Injured and Dead Trees	15.17
Percent of White Pines Injured	22.50
Percent of Red Pines Injured	9.72
Percent of Dead White Pines	2.50

ANALYSIS OF DEGREE OF DAMAGE, PLANTATION A

Species	Slight Damage		Moderate Damage		Severe Damage		Totals	
	No.	Percent	No.	Percent	No.	Percent	No.	Percent
White Pine....	5	50	1	10	4	40	10	100
Red Pine......	5	71	2	29	0	0	7	100
Total.......	10	63	3	11	4	26	17	100

Since the area of the entire Plantation A is 9.2 acres, and the area of this concentrated injury is .103 acres, the area of concentrated damage is 1.12 percent of the entire plantation. Going on the assumption that only the trees in the class under severe damage will cause a loss in future numbers, which is 26 percent of the injured trees, the probable future reduction in stocking or loss in quality is therefore 26 percent on .103 acres of the 9.2 acre plantation. The rest of the plantation is not injured by the grazing.

PLANTATION B

The area of this plantation is 13.3 acres and it is planted with red and white pine. The stock used were 3-year-old transplants, planted in 1917. Age of plantation at time of examination is 7 years. The degree of stocking is good. The entire area supports an excellent forage crop since the trees are only 4.5 feet to 5 feet in height. The animals were admitted in 1922, with 7 head of cattle in that year, and 7 head of cattle and 3 horses in 1923. Two separate areas of concentrated injury were found in this plantation and these will be discussed as separate units.

UNIT I—PLANTATION B

This area of injury is in a narrow lane on a steep slope through which the stock gain entrance to the plantation. It is approximately 150 feet in length by 50 feet in width. Its area is .17 acres or 1.95 percent of the entire plantation. The soil in this runway is moderately shallow. Both sides of the runway are fenced with barbwire. Besides the planted pines, there still remain on this area some small overtopping hardwoods. Evidence points to the fact that much of the injury was done in the winter.

ANALYSIS OF TREES ON DAMAGED AREA—UNIT I, PLANTATION B

Total Number of Trees on Damaged Area...........	41
Uninjured Red Pine	6

Injured Trees	35
Injured Red Pines	28
Injured White Pines	7
Total Percent of Injured Trees	85.38
Percent of Injured Red Pines	82.35
Percent of Injured White Pines	100.00
Percent of Trees Injured by Horses	94.28
Percent of Trees Injured by Cattle	5.72

ANALYSIS OF DEGREE OF DAMAGE—UNIT I, PLANTATION B

Species	Slight Injury		Moderate Injury		Severe Injury		Total	
	No.	Percent	No.	Percent	No.	Percent	No.	Percent
White Pine	2	29	4	57	1	14	7	100
Red Pine	9	32	2	7	17	61	28	100
Total	11	31	6	17	18	52	35	100

Since the area occupied by the concentrated injury is .17 acres or 1.95 percent of the entire area of Plantation B, the probable future reduction in density of stocking or loss in quality is 52 percent on 0.17 acres of the 13.3 acres.

UNIT II—PLANTATION B

This area extended through the plantation along several runways which the animals had made and over which they were accustomed to travel. The paths are worn down to the mineral soil. The total length of these trails is approximately 1,600 feet. In making the examination of this part of Plantation B, the trees on both sides of the runways were examined for signs of grazing injury. The area occupied by the trees on both sides of the runways is .406 acres or 3.05 percent of the entire area of the plantation.

ANALYSIS OF TREES ON DAMAGED AREA—UNIT II, PLANTATION B

Total Number of Trees Examined	495
Uninjured Trees	430
White Pine	246
Red Pine	184

Injured Trees	65
White Pine	43
Red Pine	22
Total Percent of Injured Trees	13.30
Percent of Injured White Pines	14.90
Percent of Injured Red Pines	10.7
Percent of Trees Injured by Cattle	89.0
Percent of Trees Injured by Horses	11.0

ANALYSIS OF DEGREE OF DAMAGE—UNIT II, PLANTATION B

Species	Slight Injury		Moderate Injury		Severe Injury		Totals	
	No.	Percent	No.	Percent	No.	Percent	No.	Percent
White Pine....	27	63	12	28	4	9	43	100
Red Pine......	13	59	9	41	0	0	22	100
Total.......	40	62	21	32	4	6	65	100

The area occupied by the trees on the runways is .406 acres which is 3.05 percent of the entire 13.3 acres of the plantation. Since only 6 percent of the trees injured on the area of concentrated damage fall into the class of severe injury, the probable reduction in stocking or loss in quality is 6 percent on 0.406 acres of the 13.3 acres in the plantation.

PLANTATION C

The area of this plantation is 16.7 acres. The species used was red pine, planted in 1919 when 3-year-old seedlings. Age of plantation at time of examination is 5 years. The average height of the trees is now 4 feet. The stocking of the plantation at the present time is excellent, and the area supports a good forage crop. The plantation has only been grazed since 1923 by 7 cows and 3 horses. There was found no area of concentrated injury in this plantation. This is primarily due to the fact that there is a lack of narrow gateways and lanes through which the animals are forced to travel.

Due to the scarcity of trees found to be injured by the stock, the entire field notes for this plantation are given herewith. It will readily be seen that the present damage is negligible and will probably have little influence on future losses in number of trees.

DATA SHEET—PLANTATION C

Tree Number	Species	Height Feet	Nature of Damage	Caused By
1	Red Pine	5	Bark and side branches bitten	Horse
2	Red Pine	2.5	Side branch bitten away	Horse
3	Red Pine	2.5	Tree bent over; bark scraped from side and base	Horse
4	Red Pine	3.0	Tree bent over; bark scraped from side and base	Horse

PLANTATION D

Total area of plantation is 15.4 acres. The area was planted with blocks of 3-year-old red and white pine transplants in 1921. Age of plantation at time of examination 3 years. The area of heaviest damage is restricted to a block of pure red pine, whose average height is 4 feet. The damaged area is very open, while parts of the rest of the plantation are still covered with a moderately dense stand of overtopping red cedars and sumach. It is located parallel to a fence, at one end of which there is an opening through which the stock enter the plantation. The area of this concentrated injured portion, which is 450 feet in length by 25 feet in width, is 0.25 acres or 1.6 percent of the entire area. Cattle have grazed in this plantation since the date of establishment, 6 to 8 cows annually, and 2 horses each year in 1922 and 1923. From the condition of the scars on the leaders, there is evidence that the injury was done during the winter.

ANALYSIS OF TREES ON DAMAGED AREA—PLANTATION D

Total Number of Trees Examined on Area	215
Uninjured Red Pine	171
Injured Red Pine	43
Dead Red Pine	1
Total Percent of Injured and Dead Red Pines	20.46
Percent of Injured Red Pines	20.00
Percent of Dead Red Pines	0.46
Percent of Trees Injured by Horses	100.00

ANALYSIS OF DEGREE OF DAMAGE—PLANTATION D

Species	Slight Injury		Moderate Injury		Severe Injury		Total	
	No.	Percent	No.	Percent	No.	Percent	No.	Percent
Red Pine	1	2	24	55	19	43	44	100

Of all the trees on the area of concentrated damage only 43 per cent may be classed as trees which may drop out in the future causing a reduction in stocking or loss in quality. This may cause a loss in density of 43 per cent on 0.25 acres of the 15.4 acres in the plantation.

PLANTATION E

The area of this plantation is 2.6 acres, planted with 3-year-old red and white pine transplants in 1918. Age of plantation at time of examination is 6 years. Average height of the trees is 6 feet. Degree of stocking and forage conditions are good. The entire plantation has been grazed by 2 horses annually since 1922. The damage to the trees on this plantation does not appear to be concentrated over any particular area, but is uniformly distributed. The plantation is fenced on two sides only. Due to the small size of the plantation and lack of any area of concentrated area of damage all trees on the area were examined.

ANALYSIS OF TREES INJURED—PLANTATION E

Total Number of Trees Examined on Plantation	2,696
Uninjured Trees	2,652
White Pine	1,359
Red Pine	1,293
Injured Trees	44
White Pine	27
Red Pine	17
Total Percent of Injured Trees	1.63
Percent of Injured White Pine	1.94
Percent of Injured Red Pine	1.29
Percent of Trees Injured by Horses	100.0

ANALYSIS OF DEGREE OF DAMAGE—PLANTATION E

Species	Slight Injury		Moderate Injury		Severe Injury		Total	
	No.	Percent	No.	Percent	No.	Percent	No.	Percent
White Pine	6	22	17	63	4	15	27	100
Red Pine	2	12	11	65	4	23	17	100
Totals	8	18	28	64	8	18	44	100

The injured trees occupy .036 acres or 1.4 per cent of the 2.6 acres of the plantation. The probable future loss in quality or reduction in density may be considered as being 18 per cent on 0.036 acres of the 2.6 acre plantation.

PLANTATION F

This plantation, some 19.4 acres in size, was planted with 3-year-old red pine transplants in 1914. Age of the plantation at time of examination was 10 years. Grazing has been permitted on this area since the date of the establishment of the plantation. One horse and one cow have annually grazed through the plantation. At the present time the trees have reached an age where the branches are interlaced. The ground cover of grass and other forage plants has been shaded out by the trees and replaced by a bed of pine needles. The interlacing of the lower branches and the reduction in forage plants have very materially reduced the value of this plantation for grazing. Examination shows little if any reduction in stocking as being due to previous grazing injuries. At the present time there are no signs of recent grazing injury. The density of the stand is excellent with the exception of areas where remains of old hardwood stumps still exist.

PLANTATION G

This plantation of 32.3 acres, planted in 1913 with 3-year-old white pine transplants, is 11 years old at the present time. As in the case of Plantation F, the closing in of the trees has shaded out the ground cover of grass and other forage plants, and has limited the grazing of animals to openings and along paths in the plantation. Cattle have grazed this plantation during nearly all its lifetime. An examination of the plantation at the present time fails to show any reduction in the number of trees due to past grazing. With the exception of wet areas in the plantation, the general stocking is excellent.

PLANTATION H

This plantation was established in the spring of 1924. Red pine 3-year-old transplants were used. Cattle are being grazed in this plantation. It is too early to draw any definite conclusions. An examination made a few weeks after the pines had been planted showed that very little damage had been done as yet. A few seedlings were found to have been trampled upon near the opening into the plantation.

SUMMARY OF DATA COLLECTED

Plantation	Total Area In acres	Damaged Area In acres	Percent of Total Area Injured
A	9.2	.103	1.12%
B	13.3	.576	4.33%
C	16.7	.000	0.00%
D	15.4	.250	1.60%
E	2.6	.036	1.40%
Total	57.2	.965	1.68%

SUMMARY OF DEGREE OF INJURY ON ALL PLANTATIONS EXAMINED

Plantation	Slight Injury		Moderate Injury		Severe Injury		Total	
	No.	Percent	No.	Percent	No.	Percent	No.	Percent
A	10	63	3	11	4	26	17	100%
B	51	56	27	30	22	24	100	100%
C	0	0	0	0	0	0	0	100%
D	1	2	24	55	19	43	44	100%
E	8	18	28	64	8	18	44	100%
Totals	70	34	82	40	53	26	205	100%

On Plantations A to E inclusive, comprising 57.2 acres, the areas of concentrated injury totaled .965 acres or 1.68 percent of the entire area. Only 26 percent of the trees on this 1.68 percent were injured so severely as to cause a possible loss in numbers or a reduction in the final product.

Fifty-one and seven-tenths acres of older plantations (Plantations F and G) where the stand is now closed showed no measurable damage as the result of past grazing.

CONCLUSIONS

The benefits which result from grazing in pine plantations may be summarized as follows:—

1. The fire hazard has been reduced through the reduction of the

ground cover by the animals, which has reduced the amount of dry litter left on the ground at the end of the growing season. This feature is noticeable when going from areas of the various plantations where grazing has not been permitted, to areas where grazing is allowed. Instead of the grass being shoe high or taller, the ground cover has the appearance of a well cropped pasture. When the snow leaves these grazed plantations, instead of the ground still being covered with the dried out remains of last season's vegetation, the ground is practically free from such litter.

2. The animals tend to keep down the hardwood sprouts by grazing upon them. This may materially reduce the cost of the final product since under such cases, no cleanings are necessary to free the pines from the competing hardwoods, or if cleanings are necessary they should not cost as much as if the plantations did not have animals in them to help this process along.

3. Because the animals in passing through the plantations tend to keep to certain paths, trails have resulted which are worn down to the mineral soil, and are from 12 inches to 18 inches in width. These in time of necessity could very advantageously be used as fire lines.

4. R. C. Hawley,[1] one of the authors, has pointed out that grass sod which forms the usual cover on idle agricultural lands causes heavy losses when 2-year-old seedlings are used and necessitates, under southern New England conditions, the extra cost of 3-year-old transplants to obtain a satisfactory degree of stocking. Animals, since they tend to keep down the grass cover, may possibly make it safe to use the cheaper planting stock and thus assist in reducing the initial cost of the plantation. Further experimentation with grazing in newly established plantations is needed to establish this point definitely.

The injurious effects of grazing animals in pine plantations are summarized as follows:

1. Horses are more destructive in pine plantations than cattle, due to their biting habits and their greater restlessness.

2. Winter grazing is likely to result in greater injuries to pines than grazing in the seasons when the hardwood leaves are on the trees and other forage is more plentiful. Winter grazing of horses should never be permitted in pine plantations.

3. Grazing in pine plantations is restricted to a short period 7

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[1]R. C. Hawley—Early Development of White and Red Pine Plantations. Journal of Forestry. Vol. XXII, No. 3, pp. 275-281.

to 12 years long in the early life of the plantations. During this period there is an abundance of forage between the trees. By the end of this period a closed stand is established and the forage plants have disappeared to be replaced by a cover of pine needles. The stock will not force their way into the closed stands.

4. Where conditions are normal, i. e., not in runways, paths or openings in fences or any other places where conditions are such as to force a crowding together of the stock, trees from 3 feet and up in height are safe from injury by grazing animals.

5. Severe damage by either horses or cattle is restricted to particularly exposed zones in the plantations, such as paths leading through the plantations, barways, water holes, and narrow laneways leading from one field to another. The shape of these severely damaged zones is such as to give them a width of only 15 to 50 feet.

6. The zones of concentrated damage amount to less than 1¾ percent of the plantation area. Within the zones of concentrated damage only 26 percent of the trees are severely injured.

On the whole the benefits of grazing, regulated as to season, species of animal and number of head of stock, outweigh the damage done in pine plantations.

SOME SILVICULTURAL ASPECTS OF THE CHESTNUT BLIGHT SITUATION *

By E. H. Frothingham,

Director Appalachian Forest Experiment Station

After the strenuous, costly, and unsuccessful efforts that have been made in the North to stop the spread of the chestnut blight, it seems a foregone conclusion that the chestnut timber in the Southern Appalachian region is doomed to extinction. The blight is relentlessly working its way southward, with advance guards already in the extreme southwest county of North Carolina. An amount of chestnut wood recently estimated at 33,700,000 cords is at stake, of which probably 65 percent is accessible to present use. The threatened loss has three important aspects: (1) intrinsic, through the destruction of the mainstay of existing pole, tie, tanning extract, and other chestnut using industries; (2) developmental, through the loss of a source of varied products which have contributed no small share in both economic and social development; and (3) silvicultural, through the disappearance of one of the most rapid-growing easily raised, abundant, worth-while species of the region.

With all these reasons for gloom, foresters should not be too pessimistic. While we must school ourselves to face the practical extermination of chestnut there are aspects of the situation which appear to me far from discouraging. I hope I shall be able to make these clear.

We in the Southern Appalachians have the advantage of all that has been done in the North to meet the situation caused by the blight. In New York, New Jersey, Maryland, Pennsylvania, Connecticut, and Massachusetts, chestnut has for several years been practically extinct over large areas where it once predominated. What can we learn from the records of our predecessors in the study of chestnut blight problems? It must be admitted that authoritative analyses of the post-blight situation in the North are as yet nearly unavailable. Nevertheless a canvas of the literature discloses some quite general conclusions, some expressions of opinion, and two or three investigative analyses which should be regarded in shaping our attitude toward our own blight problems.

*Read before the Southern Appalachian Section of the Society of American Foresters, Asheville, N. C., February 2, 1924.

NORTHERN VIEWS ON POST-BLIGHT PROBLEMS

After Pennsylvania's effort to stop the blight, which was practically terminated in 1913, attention was pretty generally focussed upon the utilization of chestnut timber. There is a concensus of opinion that the thing to do is to concentrate effort upon utilization, not only following but also in advance of the general infection. In the National Forests of Virginia much has already been done in this direction, and the Pisgah National Forest is now taking steps to accomplish the same thing, as already pointed out by Mattoon.[1] Chestnut cutting is being stimulated as far south as northern Georgia by at least one large timberland owner. Utilization does not fall directly within the scope of this paper, but it should be noted, in passing, that as late as 1917 sanitation measures, evidently aimed to retard the blight, were being practiced in Pennsylvania in connection with utilization.[2] It would be interesting to know whether this is still being practiced and whether the cost is justified by results.

The removal of chestnut in the North, however, has taken the form of salvage, rather than of sanitation cuttings. It is an enforced removal, sometimes varied silviculturally by efforts to control the composition of the succeeding stand. In mixed stands, for example, the less desirable species may be removed along with the chestnut, leaving a nucleus of the better species for seed trees from which desirable reproduction may result. Where chestnut predominates, most published recommendations are for planting, either before or after clearing, as the best or only means of satisfactorily restocking.[3] White, red, and Scotch pines and European larch have been tried, with varying success. Richards, in summing up the results of planting in five cases observed in Connecticut and New Jersey, concludes that pine can be established easily and quickly on cut-over land; that sprouts from the stumps of the felled chestnut are injurious; that there should be a clearing not later than 3 years after planting and every 3-5 years thereafter until the pine is from 12 to 15 feet high and a foot or so taller than neighboring hardwoods; and that while the blight will ultimately kill the whole crop of chestnut sprouts, the process is much slower than first imagined, sprouts having often been found which had reached over 2½ inches, DBH., and 15-18 feet high before dying. According to Perry, Penn-

[1]Mattoon, M. A. The position of chestnut in the timber sale policy of the Pisgah National Forest. Read before the Southern Appalachian Section of the Society of American Foresters, Asheville, N. C., February 2, 1924.

[2](See foot of next page.)

sylvania experience in converting unthrifty, slow-growing, or poor site hardwoods into planted coniferous stands indicates the need for a certain amount of follow-up work in liberation.

Because of the large areas involved and the costliness of planting, with its attendant clearings, artificial reproduction can hardly be seriously considered as a general restorative for the chestnut types in the Southern Appalachian region. It may prove eminently desirable in isolated cases, but it is apparent that we shall have to fall back almost wholly upon natural reproduction. The chief components of the silvicultural problem are (1) the amount and character of associated species in or near chestnut stands, with reference particularly to their relative value, tolerance, crown shade, and reproductive capacity; and (2) the activity of competition of chestnut sprouts until the last sprout generation has finally succumbed to the blight.

Apparently very little field work has been done to determine the actual extent and character of natural reproduction following the blight. Richards, after a sample plot study in New Jersey, found that where chestnut predominated in the stand, little was left in the way of species native to the region with which to build up a new forest. Of the native associates of chestnut, chestnut oak is the most abundant in the "hilltop" (dry) and the slope types, but it is of slow growth. Desirable species other than chestnut oak are in the minority. This led him to the recommendation of planting, previously noted.

CONCLUSIONS FROM A FIELD STUDY OF CHESTNUT REPLACEMENT

The latest field study of natural replacement is probably that by Hodson[4] for the U. S. Forest Service, in 1920. This study, which was to have been continued in the Southern Appalachians, began on the Natural Bridge and Shenandoah National Forests after which the older infected areas in Maryland, eastern Pennsylvania, and northern New Jersey were examined. Its specific object was "to learn to what extent different methods of cutting chestnut stands affect, or can influence, the succeeding stands from which it is expected that the chestnut element will be eliminated by the blight." Sixteen sample plots, aggregating a little over two acres, were studied. Ten of these were in clear cuttings made from one to five years previously; three had been cut over twenty

[2]Barnes, Leanord C. Utilization and reforesting of chestnut blighted lands. Journal of Forestry 15:854. 1917.

[3](See next page.)

[4]Hodson, E. R. Preliminary report on the silviculture of replacing the chestnut on blight-killed areas. Mss. 1921.

to twenty-five years; one was a light cutting two years old; and two were not cut over. No difference between them could be noticed as to sufficiency of reproduction. It was evidently Hodson's conclusion that clear cuttings are the best places to study natural reproduction following the blight, since they represent, in one way, the severest test, due to the removal of all seed trees and presence on the ground of only the advance reproduction and the chestnut sprouts.

Hodson's conclusions are of much interest and it is to be regretted that they cannot here be quoted in full. He finds that there is, in general, sufficient advance growth of desirable species to restock the stands. Although this may not be present in the larger sizes, so that future merchantable stands may be in some cases delayed, he believes there will be no vacant areas of any extent when the chestnut goes. In some places, especially the more unfavorable sites, Hodson found advance reproduction inadequate to restock the stand at once; where this is coupled with dense underbrush there is danger of desirable species being delayed a long time even if the sites are not permanently deteriorated as to forest cover. While the competition of chestnut sprouts has some effect upon the other elements of the reproduction, it does not appear important even with light-demanding trees unless coupled with dense underbrush or some species like dogwood or sourwood. As a general rule diseased chestnut may be cut out of the stand as heavily as may be required without increasing the shade from sprouts to an extent which will injure the reproduction.

Hodson recommends no particular method of cutting other than as dictated by purposes of salvage. In contrast to the suggestion that in newly infected areas merchantable chestnut may sometimes be left to grow to more profitable sizes, is the statement that in widely scattered spot infections the general advance of the blight may be checked by cutting the diseased trees, burning the bark and brush, and burning or peeling and creosoting the stump. Other species should be removed with chestnut where this will liberate desirable advance reproduction. Hodson believes, however, that any tree species on these areas will in

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[3]Replacement by planting conifers is discussed in the following papers:

Toumey, J. W. What should be done with the chestnut stands in southern New England. Proceedings Society of American Foresters 9:38. 1914.

Richards, E. C. M. Reforesting cut-over chestnut lands. Forestry Quarterly 12:204. 1914.

Richards, E. C. M. A study of reforested chestnut cut-over land. Journal of Forestry 15:609. 1917.

Perry, Geo. S. The special planting problems in Pennsylvania. Journal of Forestry 20:507. 1922.

all probability have assumed value by the time they are mature. Finally, Hodson considers commercial cuttings inadequate, at best, wherever the stands have dense underbrush or unmerchantable trees are in large proportion; improvement cuttings are here needed.

CHESTNUT REPLACEMENT IN PENNSYLVANIA

The generally optimistic tone of Hodson's conclusions is shared by Illick,[5] for Pennsylvania conditions. The belief which prevailed during the height of the epidemic, that numerous vacancies aggregating an enormous area would be created and remain for a long while unoccupied, or at least poorly stocked with valuable trees, was shown to be incorrect in places where the blight had passed its final stage. "Natural replacement is more complete and better in quality and quality increment than was anticipated," says Illick. "The blanks left—are fewer and less extensive than was formerly predicted. Foresters and woodsmen are now heard to say: 'We do not miss the chestnut as much as we thought we would;' 'We can get along without the chestnut;' and 'We had the chestnut to spare.' The problem is, therefore, in many places, not one of forest tree restoration on blank vacancies, but of the control of forest tree replacement."

"In moist situations," Illick continues, "The replacement will be more complete and more satisfactory than upon the drier slopes, for in such places the vacancies will be relatively less extensive and the companion species more desirable, among them being the tulip tree, white ash, red oak, white pine, red maple, white oak, and a few other species. Upon the drier slopes the vacancies will be more extensive and the companion species less valuable. Upon some sites and in special places the natural growth may not suffice to establish satisfactory stands. In such places the natural growth should be supplemented by planting," and he suggests pitch, jack, and Scotch pines for these places. Illick regards chestnut oak, pitch pine and black locust as among the satisfactory species which are largely replacing the chestnut in Pennsylvania. Black oak, pignut hickory, black birch, table mountain pine, and Jersey or scrub pine are others which are helping fill in the gaps and which are not, in Illick's opinion, to be despised. It is noteworthy that observations made as late as 1923 by C. F. Korstian, in company with members of the State Forest School, at Mont Alto, amply substantiate for

[5]Illick, Joseph S. Replacement of the chestnut. Journal of Forestry 19:105. 1921.

Franklin Company, Pennsylvania, Illick's belief that blighted areas will largely be restocked by natural reproduction.

Having thus reviewed some of the findings and opinions as to post-blight conditions in the North, we can consider with somewhat more assurance the situation which exists today in our own territory. What resemblances and what distinctions can be drawn between the forest conditions of the two regions, which will have a bearing upon the silviculture of chestnut blight? What conclusions reached in the north are we justified in accepting? Is further study on our part necessary or desirable, and if so, what lines should it follow? Each of these questions is, of course, subject to various answers. My own views are offered merely to start the ball rolling.

PROSPECTS FOR NATURAL REPLACEMENT IN THE SOUTH

The most prominent and significant difference between north and south lies in the greater number of species with which chestnut associates in the southern part of its range. It is safe to say that no other Southern Appalachian species equals chestnut in the range of sites upon which it is able to establish merchantable trees or stands. Except for lime soils, which are of limited occurrence in the region, it is found from moist cove to dry ridge, on slopes of all exposures, and at all altitudes in the mountains up to 5,000 feet and perhaps higher, in the southern ranges. This ubiquity doubtless goes hand in hand with its abundance. In this wide range of sites it meets and competes with over fifty tree species of more or less commercial value and with a great variety of shrubs and shrub like trees. Most of these are broad-leaved, reproducing by both seed and sprout. Some of them are of rapid growth, equalling or even exceeding that of chestnut. Some excel chestnut in durability of the wood, though of smaller size and less productive of poles and ties. Others are possibilities for tanning material in bark, leaves, or even wood, though none can compare with chestnut in yield of raw tanning extract product. If natural replacement is generally effective in the North, it ought to be more so here, making due allowance for the presence of many species at present of little or no value.

The relative merits of these species from the standpoint of replacing chestnut depend upon their aggressiveness in reproduction, their growth rate, and the potential value of their products. All of these have a direct relationship to site. They are too involved for discussion in a short paper, and in fact they cover a good many things about which we are still hazy. It will be in place, however, to mention some of the more

common tree species with which chestnut associates on the different sites; for the most part the reader will have to supply his own opinions as to the capacity of the several species to restock openings, succeed or fail in competition, and produce useful materials.

On high, cool, moist sites, below the spruce belt, chestnut is of minor importance in stands characterized by "northern hardwoods" (birch, beech, maple), hemlock, buckeye, basswood, cucumber, white ash, black cherry, and red oak. There is no question of replacement here. In exposed, rocky situations at equal or only slightly less altitudes, chestnut may heavily predominate in poor, scrubby stands, of little or no value even for wood because of low yield and difficulty of access. Buckeye, yellow birch, and other species in mixture will undoubtedly, in course of time, replace the blight killed cover.

The coves and adjoining moist lower slopes are the best forest soils of the region and support the greatest number of species. Growth is rapid and competition active. The many associates of chestnut in these sites include yellow poplar, red oak, white oak, hemlock, white pine, basswood, shagbark hickory, white hickory, bitternut hickory, cucumber, white ash, black cherry, buckeye, red maple, sugar maple, beech, black birch, black gum, walnut, butternut, black locust, sycamore, silverbell, sourwood, sassafras and dogwood. Other species, such as black chestnut, and scarlet oaks and pignut hickory, more characteristic of drier sites, intrude freely into the coves. It is significant that several of the most valuable of the cove species are intolerant or only moderately tolerant. This places them at a disadvantage in restocking areas in competition with trees of greater shade endurance, although, as in the case of yellow poplar and black locust, this may be compensated by abundance of reproduction and rapid early growth.

On ridge tops and dry upper slopes at moderate elevations chestnut associates with chestnut oak, scarlet oak, black oak, white oak, black jack oak, black gum, black locust, pitch pine, shortleaf pine, table mountain pine, red maple, pignut hickory, dogwood, sassafras and scrub oak. Chestnut may be quite abundant in relatively moist spots, but the drier portions are usually occupied by more resistant species.

It is on the intermediate slopes and benches that chestnut is most important. These lands make up the greater part of the forest land area of the Southern Appalachians. It is needless to list the tree associates of chestnut on these sites; they include the upper slope species previously enumerated together with many of the less exacting species

of the coves. Chestnut forms a large proportion of the merchantable stand. Except for occasional second-growth sprout woods, however, pure stands of chestnut are rather the exception on the intermediate slopes. There are almost always other species in the advance growth or within easy seeding distance of any point.

On all sites competition in the early juvenile stage is, of course, to be expected from usch shrubbery associates as laurel, rhododendron, and various huckleberries and blueberries.

Although chestnut is doubtless the most abundant commercial tree species in the Southern Appalachians, with a volume sometimes estimated at half the total merchantable stand, it is not found, as a rule, in stands of such purity as are common in the northeastern part of its range. This is very likely due to the fact that it is still old growth which was left standing, along with species not then merchantable, when the hardwood forests in this region received their first cullings. Without the spreading and aggressive growth of sprouts that would have followed active cutting of the chestnut, advance growth of other species would have little difficulty in filling the openings, and any further increase of the chestnut might thus have been prevented. In the North, on the other hand, it has been suggested that the proportion of chestnut has been increased as a result of repeated logging. It is reasonable to suppose that successive coppicing of hardwood stands will end in the supremacy of the most successful sprout reproducer. The phenomenal sprouting of chestnut, by carrying it through repeated generations of woods which are largely coppice, might readily result finally in exclusive chestnut stands. The logging history of the Southern Appalachians is very much more brief than in the earlier developed regions to the north, by virtue of which we are apparently somewhat better off with respect to the blight. With less chestnut in pure stands we are silviculturally in a better position for natural replacement with other species.

WILL THE BLIGHT OCCASION A HEAVY LOSS OF INCREMENT?

That there will be a heavy loss of valuable chestnut timber through sheer inability of existing agencies to exploit all of it seems a foregone conclusion. That there will be an aggregate loss of increment is possible. But that this growth loss will be very large is extremely doubtful. It is true that the growth rate of chestnut is more rapid here than in Connecticut, for example, but so is that of associated species.

Wherever chestnut occurs it has associates not far inferior or even

exceeding it in growth rate. In the coves yellow poplar exceeds it, and red oak, white pine and others probably equal it. On intermediate slopes, black oak, scarlet oak, and black locust are not far, if at all, behind chestnut. On upper slopes, various pines doubtless exceed it, and on ridge crests chestnut oak and other frugal species tend to exclude it altogether. The inference is that once the blight-killed openings are restocked, increment will go on much the same as before the chestnut disappeared. There will be a differential, of course, but not of the extreme proportions we have sometimes feared.

In order to check this inference to the extent possible, a comparison was made of the cubic yield of plots used in the preparation of yield tables for southern upland hardwoods. For these tables 370 sample plots, mostly measured by W. W. Ashe and F. W. Besley in Maryland, were utilized. Ninety of these were in stands in which chestnut formed 50 percent or more of the total cubic volume, 50 in stands in which chestnut predominated but formed less than half the volume. These two groups of chestnut plots form about 38 percent of the total number of plots, showing that the yield tables are not over heavily based upon chestnut.

The striking thing about these plots is that the majority of the chestnut plots conformed in both volume per acre and height of dominant trees to the yield tables which were finally produced as representing average growth of well-stocked, even-aged, second-growth hardwoods of all the upland species. Of the 29 percent which did not conform, 17 percent exhibited too great and 12 percent too little volume. Moreover, the percentage of *chestnut* plots thrown out because they departed too far from average yields was slightly less than the percentage of *all* plots so discarded.

The evidence of these plots tends to substantiate the assertion that eventually chestnut will not be very greatly missed from a growth point of view. In this respect the findings are at variance with the estimate made by Ziegler[6] for certain Pennsylvania conditions.

There is another aspect of this matter which must be considered. It is a tenet of silviculture, handed down from European practice, that mixed stands produce larger yields, larger sizes, and better quality of timber; are less exposed to windfall and snowbreak or to attacks of noxious insects and fungous diseases; are easier to modify with refer-

[6]Ziegler, E. A. Problems arising from the loss of our chestnut. Forest leaves, August, 1920.

ence to changes in the timber market; are more easily reproduced naturally; and are more picturesque.[7] These may not all hold in the case of chestnut; but the truth of the dictum regarding fungous diseases is now being demonstrated.

If we accept the theory that chestnut extends its tenure after cutting, and that each successive cutting still further increases the proportion of chestnut, then we are certainly in the way of losing a most valuable growth asset. Worked on short rotations, the bulk of the Southern Appalachian hardwoods might conceivably have become—but for the blight or some other fungous or insect epidemic—a great chestnut coppice. But if we are satisfied to preserve a mixed forest containing both short and long rotation material of great variety, then, after the first period of economic loss, it may reasonably be questioned whether we shall not be at least as well off without the chestnut.

WHAT THE SITUATION DEMANDS

The review of the chestnut blight situation attempted in the preceding pages suggests the following conclusions:

1. Efforts to stop or even control the spread of the chestnut blight are not justified from previous experience. After the strenuous and costly efforts which have been made, the foresters view, subject to confirmation by forest pathologists, may well be that the expenditure of additional funds to this end is inexcusable.

2. The first need is to secure effective utilization of chestnut. The amount of chestnut is so large that it makes the problem of anywhere near complete utilization of the chestnut a very difficult one. Steps to secure it should therefore be taken right away, even in advance of heavy infection. Where additional growth warrants a race with the blight, chestnut operations may be concentrated upon other places less favorably situated.

3. Successive, short-lived generations of sprouts from blight-killed chestnut, with their tendency to spread out and, with numerous shrubs and reproduction of inferior species, to monopolize growing space, constitute a menace to other hardwood reproduction. This is augmented in mixed stands by shade from living trees of other species. The tendency of the crowns of "holdovers" to expand and fill openings left by death of chestnut provides a shade reinforcement still further embarrassing to reproduction. In the Southern Appalachians the prob-

[7]Nisbet, John. The Forester. Vol. 1, p. 347.

lem is rendered acute by the fact that some of the most desirable tree species are not able to endure prolonged shading.

4. Unless controlled, the outcome of this will possibly be the favoring of the more shade tolerant species and the reduction of the proportion of light needing species, as compared even with the results which might be expected after ordinary lumbering operations. A large part of the Southern Appalachian forests have already been repeatedly culled of their better trees, leaving the forests worse off in both composition and quality. The effect of the chestnut blight is in the direction of accentuating this tendency.

5. It seems certain that barring fire and other destructive agencies there will almost always be a natural replacement of some sort or other. In the exceptional cases where this does not take place, or where it bids fair to be unduly delayed, the only resort is to planting. There are many native and exotic species from which to choose for planting; the selection should, of course, be based upon the usual criteria of suitability to site, rate of growth, records of performance, and intrinsic worth of the final product.

With the experience of the North before us and with these surmises as to the impending conditions in Southern Appalachian hardwood forests as a result of the blight, the questions naturally arise, can anything be done in the situation? Shall we be satisfied merely to save what we can, here and there, of the existing chestnut, or shall we attempt a systematic and thorough utilization? Shall we then let the forest take care of itself without regard to consequences, or shall we take steps to discover and apply means for replacing chestnut not only with trees, but with species of trees which will represent in final returns the best growing capacities of the forest lands? These questions demand immediate answers. If the answers are positive we can not afford to risk delay.

In the writer's opinion, immediate and positive action is necessary. This action should take the form, on the one hand, of systematic utilization and, on the other, of short but comprehensive investigations to verify or extend to our own conditions all experience and opinion as to the recovery of blight killed areas. This appears to involve a procedure something like the following:

1. *Determination of Rate and Character of Spread.* Close and constant track should be kept of the location and size of blighted areas, the occurrence of new infections, and the spread of the blight from

these areas. This will be in the interest of systematic utilization and of the practice of any incidental silvicultural betterments that may be possible.

2. *Utilization.* The matter of concentrating utilization at strategic points involves marketing facilities, size of timber, growth rate, and other factors. It is one of the difficult features of the situation, and will demand concerted action of all interests. Studies should be made to determine the best methods of storing chestnut products. From a silvicultural point of view the subject has a bearing upon the treatment of infected stands and also of uninfected stands in advance of the blight. For instance the question of the duration of sap-wood of blight-killed and of girdled healthy trees may prove important, and it may also be worth while to ascertain whether girdling infected trees may not be effective in preserving the wood.

3. *Studies of natural replacement.* A thorough study should be made of blight-killed areas in the earlier and more recently infected regions to learn the sequence of vegetation upon them. This should be done by means of sample plots carefully selected with reference to type and site conditions in the Southern Appalachians. It would be generally similar to the study by E. R. Hodson, previously discussed, but should be extended so as to be representative of all important chestnut sites.

4. *Studies of cultural replacement.* These involve the determination of means and costs of establishing reproduction of desirable species in the place of chestnut. They should be carried on in conjunction with the studies of natural replacement, and should ascertain the conditions under which liberation cuttings of chestnut sprouts or other growth are necessary. To a large extent such studies should be experimental, affording small scale demonstrations of actual operation. Various means of reducing the sprouting vigor of chestnut and eliminating or decreasing high overhead shade might well be tried out.

These four lines of investigation will perhaps suggest others. The composition of our forests may best be molded in the initial stages of growth. It is therefore highly important that means be found to carry on these or similar studies on a scale commensurate with the widespread, radical change that will result from the disappearance of our most abundant and one of our most useful tree species.

ARTIFICIAL REPRODUCTION OF REDWOOD

(SEQUOIA SEMPERVIRENS)

By Woodbridge Metcalf

Redwood is one of California's most important timber trees. The annual cut of approximately half a billion board feet of redwood is slightly more than one third of all the lumber produced in the state—a large contribution to the economic well being of many industries. The original redwood forest occupied about a million and a quarter acres of which area less than one-fourth has been cut over. Agricultural experts, who have studied the redwood region estimate that only about ten percent of the original acreage of redwood land can be used for farm crops. The rest will probably always be most valuable for growing its original crop—redwood timber. Recent studies show that redwood in fully stocked stands will produce lumber faster than any other softwood species. Growing redwood is therefore a good business investment which fact has been recognized by the adoption, during the past year, of a policy of permanent forest production by a majority of redwood timber operators. Two of these have established forest nurseries for the growing of young trees, and several others are planning to do likewise. The results of studies of artificial reproduction of redwood are here briefly presented in the hope that they may be of assistance to those who will be engaged in growing the redwood crop of the future.

SPROUT REPRODUCTION NOT ADEQUATE

Redwood is notable among coniferous trees for the remarkable vigor and rapidity of growth of its sprout reproduction. The stumps on cut-over areas are, within a few months after logging, surrounded by hundreds of sprouts or root suckers which grow with great rapidity if protected from fire. In most cases enough sprouts are present to give a fully stocked stand *if they were evenly spaced* over the area. Unfortunately most of them originate within a few feet of a stump; which results in densely crowded clusters about each of the widely separated stumps and a relatively large percentage of unoccupied land. In order to insure maximum volume growth on each acre as well as to induce the early crowding necessary to produce clear lumber these openings must be filled with planted trees, as the leaving of seed trees is apparently impracticable under modern logging conditions. The following summary compiled in connection with a thinning experiment in Mendocino Coun-

ty, shows conditions characteristic of cut-over areas and emphasizes the need for planting.

SMITH CREEK—PLOT I

Area 0.607 acres........................Age of sprouts 5 years
Number of stumps per acre....................46
Average diameter of stump....................35 inches
Number of sprouts per stump..................72
Number of sprouts per acre..................3337
Sprouts less than 3 ft. high..................... 3.0%
Sprouts 3-6 ft. high.........................32.9%
Sprouts over 6 ft. high......................64.1%
Proportion of area occupied by sprouts..........10-15%

USE OF SPROUTS IN ARTIFICIAL REPRODUCTION

The suggestion has often been made that it might be possible to move some of the sprouts from stump clusters to adjacent openings and thus save nursery and transportation costs. This method seemed to have considerable promise of success when on examination it was found that many of the root suckers are provided with rootlets of their own. (See Fig. 10).

A number of tests with such rooted suckers were made by V. Davis and C. Gerhardy of the Union Lumber Company in the winter and spring of 1921-22. Sprouts of various sizes both with and without rootlets, were set in several different planting areas. Some of these were pruned and others were left unpruned but all failed to take root. The same result was obtained with sprouts from Santa Cruz County (Fig. 10), planted at Berkeley, November 1922.

Somewhat better results were obtained with rooted suckers set in transplant row and adjacent planting area at Berkeley in December 1921. Those in the transplant row received irrigation about once in three weeks and the others had water once a month during the dry season. The results were as follows:

GROWTH OF ROOTED SUCKERS

Collected—Mendocino County, December 1921.
Age—One and two year sprouts.

Where Planted	No.	Treatment	Condition Dec. 1922	Percent Survival
Transplant row	45	Trimmed	Good	26†
Planting Area	12	Not pruned	Fair	25
Planting Area	8	Pruned to 4″	Good	25

†A few others rooted successfully after five months longer in the sand flat.

Those which survived in the transplant row had splendid branching root systems but rather poorly developed tops. (See Fig. 11). The pruned sprouts look thrifty but made slow growth being smaller than the average of 1½ year seedlings. The unpruned sprouts were planted in poor gravelly soil and made practically no growth the first year.

It seems evident from these experiments that rooted suckers cannot be used for planting stock unless held for a year in the nursery. The large amount of loss (75%) and the fact that the stock thus produced is too large for economical handling seems to eliminate the sprouts from consideration.

CUTTINGS

During the fall and winter of 1921 a number of tests with cuttings of various sizes were carried on with the following results:

Character of Cutting	Where Planted	Date Planted	Number	Percent Successfully Rooted
Heavy wood from 2-3 yr. sprouts	Seed bed in nursery	Dec. 10, 1921	206	6.7 Oct. 1922
Green wood and tips from 2-3 yr. sprouts	Seed bed in nursery	Dec. 10, 1921	50	72*
Tips of twigs and branches from 2-3 yr. sprouts	Seed bed in nursery	Dec. 13, 1921	134	63*
2″-3″ tips and branch ends with buds	Sand flat in laboratory	Oct. 16, 1921	90	24.4† in 8 months
12″-14″ tips of sprouts	Sand flat in laboratory	Oct. 16, 1921	15	6.6†

A period of eight to ten months is required for the formation of a callous and the starting of root growth. (See Fig. 6). About half of the cuttings do not produce roots although a well developed callous is present. It will be noted that the roots develop practically at right angles to the stem which makes them very difficult to transplant without injury.

All of the above cuttings were set out in a transplant row in the

*This percentage still green and having a good callous. Only about half show well developed roots.

†A few others rooted successfully after five months longer in the sand flat.

nursery on October 25, 1922. When examined May 31, 1923, the results were as follows:

Character of Cutting	Number transplanted	Percentage loss in transplanting	Tree percent of original number of cuttings started
Second year wood	14	58%	2.9%
Tips from sand flats	22	81.9%	4.4%
Tips from nursery bed	120	89.1%	7.0%

On the basis of the above figures it is evident that, while a small percentage of success has been obtained with cuttings, the method cannot be considered a satisfactory one for use on a large scale. The time required for rooting is too long and the plants produced are of too poor a form to compare favorably with seedling stock. A number of cuttings were tried by Davis at the Fort Bragg nursery with even less satisfactory results than those outlined above so that the method must be discarded as too expensive and impracticable.

WILD SEEDLINGS

The preponderance of sprout reproduction in the redwood region is so great that many people are under the impression that redwood never reproduces itself naturally from seed. A careful search in almost any stand of redwood will however reveal a few seedlings and in certain favorable localities several hundred have been counted on an area ten feet square. Seedlings are particularly numerous in openings along Powder Mill Creek, Santa Cruz County and along the railroad right of way on the upper Noyo River, Mendocino County. The presence of exposed mineral soil together with favorable moisture conditions and some shade, seem to be necessary for successful establishment of seedlings. Occasionally, however, a thrifty tree has been found growing in the accumulation of rotting wood and leaves on old logs.

Wild seedlings vary greatly in size, vigor, and root development. (See Fig. 9.) The tops are often spindly because of excessive shading and the root system is usually spreading and poorly developed. The following summary of tests with wild stock show that it is of doubtful utility for use in planting operations unless held for a year in the nursery to improve root development.

Source of Stock	Where Planted	Date	No. Planted	Percent Survival
Santa Cruz	*Berkeley nursery	10/24/21	45	22% Good
Santa Cruz	*Berkeley Plantation not pruned	10/12/22	8	50% Fair
Santa Cruz	*Berkeley Plantation pruned to 2″ high	10/12/22	7	43% Fair
Mendocino	Campbell Creek, Plantation	Dec. 1921	142	11.5% Good

Even with some irrigation the wild stock makes practically no height growth the first year. After it becomes established however, it makes very rapid growth under favorable conditions. (See Fig. 5.) The remarkable growth of this seedling during its second year was undoubtedly because it happened to have a good root system, and because it was irrigated about once a month during the dry season. A large number of redwood trees for ornamental purposes have been successfully grown from wild stock (see Fig. ??) and are thriving in many parts of California. Wild seedlings are however, of too infrequent occurrence and too variable in development to offer a satisfactory solution to the problem of obtaining the millions of trees necessary in reforesting redwood cut-over lands.

SEED PRODUCTION

It has long been a matter of record that the blooming period of redwood trees varies from late November to early March and that the cones mature sometime during the following autumn. Redwood seed has been handled by seed dealers for many years but, when the present series of experiments were begun at Berkeley in 1916 it was found that very little accurate information was available concerning its production and quality.

The writer carried on a number of experiments from 1916 to the present and supervised the work of H. C. Lott who as Bidwell Research Assistant in Forestry made a careful study of the seed crop of 1922. Based on these studies the following brief statements concerning seed production may be made.

(1) Some seed is produced in the redwood region each year by trees of all ages from seven to fifteen hundred years.

*Received some irrigation in dry weather.

(2) The maturity of seed cannot be accurately determined by cutting sections through the cones. Seeds collected before August 17th, though apparently well filled, were not ripe enough to give any germination, while those collected September 21st did not differ materially in actual germination from seed taken from the same trees two months later. Maturity of seed is best indicated by yellow color of the cones or slight separation of the cone scales. The period of seed collection in 1922 was from Sept. 21 to Dec. 1. After the latter date practically all cones had opened on the trees.

(3) The average cone contains sixty seeds and 9.01 pounds of green cones averaging 227 cones per pound are required to produce one pound of clean seed.

(4) Seed may be collected in one of three ways:

(a) From felled trees during logging operations.

(b) From squirrel caches or from the ground under trees in which the squirrels are working.

(c) From second growth trees by climbing the tree and throwing down branches with clusters of cones.

Method (a) has not been very satisfactory because of the difficulty in getting around among the mass of tangled trunks and branches. Method (b) seems to be the most satisfactory method in collecting from mature trees. Squirrels cut large quantities of cones and it is often possible to pick up from ten to fifteen pounds of cones under a single clump of mature trees.

Method (c) is applicable only to second growth and the work is very laborious. Under good crop conditions about 75 to 100 pounds of cones per day can be collected by one man using this method.

(5) Seeds produced by trees of the first age class (less than 20 years) have a viability generally less than 1%. The viability increases with increasing age of the tree reaching a maximum some time after 250 years. Seeds produced by very old trees (1,200-1,500 years) are sterile or do not exceed 3% in viability. The largest seed in 1922 came from trees 60-100 years of age.

(6) The best seed in 1922 came from stands of medium density of crown which grew on benches or slopes; on sites estimated to be of better than average quality. Good quality seed is apparently not produced either by very dense or very open stands.

(7) Mendocino County seed of the 1922 crop was of much better

quality than that collected in Humboldt, Sonoma, Marin, Contra Costa or Santa Cruz counties.

(8) The number of seeds per pound for various lots of seed is shown in the following table:

WEIGHT OF CLEAN REDWOOD SEED

Source of Seed	No. of Samples	Tested by	Percent Purity	No. Clean Seed Min.	No. Clean Seed Max.	Per Lb. Av.
Commercial	7	J. Rafn, Denmark, 1887-1912	72.8	83,717	131,535	104,272
Commercial	Not stated	J. W. Toumey, Yale, 1900-1910	83.0	....	....	162,200
Smith River, Humboldt Co.	1	C. R. Tillotson, U. S. F. S., 1910	....	....	....	238,000
Luffenbok Creek, Humboldt Co.	1	Metcalf, 1916	....	....	....	160,000
Monterey Co.	1	Metcalf, 1919	....	....	....	104,328
Santa Cruz Co.	1	Metcalf, 1919	....	....	....	95,256
Santa Cruz Co.	1	Metcalf, 1920	....	....	....	97,070
Commercial 1921 Santa Cruz Co.	1	Metcalf, 1921	....	....	....	139,708
All Samples 1922	147	Lott, 1922	97.8	59,000	300,000	123,310
Commercial 1922	3	Lott, 1922	99.	98,400	128,800	103,600

SEED EXTRACTION

Redwood cones can be dried in shallow trays, at room temperature, with good circulation of air supplied by an electric fan, in ten to fourteen days. Each lot of cones must be stirred up at about two-day intervals in order to insure even drying. The Union Lumber Company extracted seed from over a thousand pounds of cones in November and December, 1922. These were spread out in shallow boxes in a cabin heated by a wood stove. The period required for drying under these conditions was more than double that under laboratory conditions and in spite of repeated stirrings it was difficult to prevent some mildewing. It therefore seems highly desirable to use some type of extractor which, by using higher temperatures and forced circulation of air will materially shorten the period of drying and prevent any trouble with mildew.

In order to determine in a preliminary way the influence of higher temperatures on redwood seed, a series of tests were run under controlled

temperature conditions in the dehydrator of the Fruit Products Division, at Berkeley. Temperatures of 100, 120 and 140 degrees Fahrenheit were used for periods of 5, 10 and 15 hours with a wind movement of about 250 feet per minute. The seeds used had been previously extracted at room temperature (no cones were available when this test was made, Feb. 1923) and proven by test to be of good viability.

Each sample of seed was weighed both before and after drying to determine moisture loss following which 60 day germination tests in duplicate were made with the seed of each sample. The results are shown in the following table:

EFFECTS OF DEHYDRATION ON REDWOOD SEED

Temperature Degrees F.	No. of hours	Progress of Germination in Percent*				% Good after 60 da.
		15 da.	30 da.	45 da.	60 da.	
100°	5	3	17.5	29	35	18.5
100°	10	4	22.5	26.5	32	13
100°	15	1	15	24	32	13
120°	5	2	18.5	23.5	28	15
120°	10	2	12	17	20.5	16
120°	15	2	16	21	27.5	14.5
140°	5	1	15	20.5	28	21
140°	10	1	9.5	12	18.5	16.5
140°	15	1	10	14.5	22.5	20.5
Untreated	..	3	16	24	27.5	18.5

It seems evident from the above figures that air seasoned redwood seed can stand a temperature of 140° F. for fifteen hours without appreciable loss in viability. It is probable that the effect of similar temperatures on seed in green cones will be slightly different but it would seem that temperatures of 120° F. to 130° F. can be used in redwood seed extraction with perfect safety. On the average, redwood cones lose 60% of their green weight during the process of seed extraction.

GRADING REDWOOD SEED

Experiments have shown that seeds of different size show constant differences in cutting test, rapidity of germination and rate of growth. It is therefore highly desirable to grade redwood seed after extraction

*Average of duplicate tests.

into two size classes. This can be accomplished by shaking the seed through standard copper wire screens having 6, 8 and 10 wires to the inch. The cones and large pieces of twigs will remain in screen No. 6; practically all of the viable seeds will be caught in screens No. 8 and No. 10, while inferior seeds, chaff and resin will pass through and can be discarded. In our experiments a screen with 12 wires per inch was also used but in practically all cases the seed caught by this screen was too small and inferior in germinative capacity to warrant saving it for nursery use. The 147 lots of seed from the 1922 crop graded according to this method showed the following average percentages by weight: Screen No. 8, 60%; screen No. 10, 31%: screen No. 12, 7%; chaff and resin 2%. Rarely some seeds will remain in screen No. 6 but it will usually be found that these are made up of smaller seeds stuck together. They may be separated by rubbing gently through the screen or they may be safely mixed with the No. 8 seed in sowing.

GERMINATION TESTS

Cutting test. The simplest and most rapid method of testing seed is by cutting a number (usually 100) with a knife and counting the number which show bright colored oily kernels. This number is usually higher than those which are actually capable of germination, but it is generally accurate enough to use in nursery practice (see discussion of safety factor in later paragraph). Caution should be used in discarding, during the cutting test, seeds which are oily but have a dark colored endosperm. Mendocino seed samples in 1922 contained several percent of seed of this character which later tests showed to be viable.

Actual germination tests. All germination tests at Berkeley have been carried on in a standard water jacketed germinating chamber at a constant temperature of 20° C. (68° F.). Duplicate tests of 100 seeds each were placed between moistened blotters and examined at two day intervals. Most of the tests were run for 60 days although a few have been left for over 100 days, the blotters being kept moist by occasionally sprinkling with distilled water. The average germinative energy period of redwood seed under these conditions is about 35-40 days but individual samples show much variation from this. The following table shows the average rate of germination of seeds of different size compared to that of unscreened samples. The table also shows the relation between cutting test and actual germination.

RATE OF GERMINATION OF REDWOOD SEED

Crop Year	Screen No.	No. of Samples	Cutting Test Percent	Germination Percent in Blotters at 20° C.				% Sound at end of test
				14 da.	28 da.	40 da.	60 da.	*
1921	Unscreened	1	30	7	13.5	15	17	2.5
1921	8	1	42	8.5	16	16.5	18.5	1
1921	10	1	16	4	9	9	10	1
1921	12	1	12	0	1.5	1.5	1.5	0
1922	Unscreened	94	15.2	4.2	8.8	10.1	10.6	4.3
1922	8	96	16.0	5.2	11.0	12.0	12.0	3.6
1922	10	47	12.1	3.7	7.7	8.4	8.4	3.3

This table shows that from one half to two thirds of the seed indicated as viable in the cutting test, actually germinate in 60 days under laboratory conditions. The proportion of germination under nursery conditions is much lower. The table also shows that the seed of screen No. 8 has a higher germination percent and germinates more rapidly than the seed of smaller size.

GROWTH OF REDWOOD IN SEEDBEDS

Satisfactory stands of seedlings have been raised in the Berkeley nursery from seed crops of several successive years. Negative results with early sowings were probably caused by the use of old seed or seed which came from very old trees. In 1917 several seedbeds were sown with fresh seed of the 1916 crop collected from trees averaging 1,600 years old. These were complete failures. Commercial seed purchased the following year failed to germinate. Since that time at least a few seedlings have been raised from each lot of seed sown, and for the last two years, very uniform stands of thrifty seedlings have been secured both at Berkeley and at Fort Bragg.

No special treatment is necessary in sowing redwood seed. It should be sown broadcast on well worked and carefully smoothed soil, slightly pressed into the soil with a flat board and covered not to exceed ⅛ inch with coarse sand or light sandy loam soil. A strip of burlap may be pinned down over the soil to prevent excessive evaporation, but should be removed as soon as germination starts. In most places seedbeds must be screened to keep out birds and, until the end of the first growing season, the seedlings will make better growth if given half shade with

*These may be considered as worthless for nursery purposes.

lath frames. This will assist in maintaining sufficient moisture in the upper layers of soil which is very important for the first few months.

Damping off. At Berkeley some beds have been treated after sowing with 3/16 fluid oz. of commercial sulphuric acid per square foot of surface. The acid is mixed with several gallons of water and sprinkled evenly over the bed after the seed have been covered. This treatment adds to the expense of raising seedlings and is of doubtful utility as redwood seems to be rarely attacked by damping off fungi. Untreated beds have given just as good stands of seedlings as treated beds both at Berkeley and at Fort Bragg. Some dead seedlings may always be found scattered through seedbeds during the early stages but this seems to be due in most cases to drought or to small seed having insufficient nourishment. V. Davis reports a rather severe attack of damping off late in March 1923 in a series of beds sown early in February. The attack came after several weeks of warm, dry weather; was quite serious for several days but stopped as quickly as it started both in untreated beds and in those where flowers of sulphur, and varying concentrations of H_2SO_4 or formalin had been applied in an effort to check the disease. The strongest solution used to check this outbreak was 4 oz. of H_2SO_4 in 9 gallons of water per 48 sq. ft. of bed. This seemed to have some value in checking the fungus but caused a slight browning of the foliage of some trees. The discolored plants seemed to suffer no permanent injury from the acid.

Experience with other coniferous species in seedbeds seems to indicate that when damping off injury is bad the losses in treated beds are almost as great as in untreated beds and that, even with more susceptible species than redwood, damping off losses are serious only at intervals in a series of years. On the basis of the single outbreak in redwood seedbeds the expense of acid treatment of all beds does not seem to be justified.

Date of Sowing. Satisfactory stands of redwood seedlings have been grown from seed sown any time between Dec. 1st and April 15th, but winter rather than spring sowing seems to be preferable for the following reasons:

(a) Seeds are not subjected to such hot, dry weather during germination and consequently do not require so much attention to shading and irrigation.

(b) Winter sown seeds germinate as soon as temperature conditions are favorable and, because of more favorable moisture conditions

make much more rapid growth during their first year than spring sown seeds.

(c) Practically all seedlings from spring sown seed require a year in the transplant row before planting in the field. About 25% of the seedlings from fall sown beds can be set directly in the plantation.

The influence of date of planting on early development of redwood was tested at Berkeley by sowing a given weight of seed of the same lot at fifteen day intervals from Dec. 1st 1922, to April 15th 1923. The seed used came from 55 year old trees in Santa Cruz County. The cutting test showed 23% viable and 7% actually germinated in the oven in 60 days. The number of seeds per lb. was 97,977. Thirty grams of seed were sown each time in 4 sq. ft. of seed bed. The rate of germination is shown in the following table:

INFLUENCE OF PLANTING DATE ON GERMINATION OF REDWOOD SEED

Date of Planting	Number of days to commencement of germination	Number of days for complete germination	Number of trees per sq. ft. June 4
Dec. 1	80	120	116
Dec. 15	70	110	180
Jan. 10	75	110	120
Jan. 15	55	100	250
Jan. 31	50	90	92
Feb. 16	45	70	100
Mar. 1	40	60	132
Mar. 15	40	60	132
Mar. 31	30	50	110
Apr. 15	20	..	64

On June 4 the seedlings of the first four lots will average nearly twice as large as those of the last four lots. Column 4 shows that more seedlings became established in winter sown beds than in spring sown beds from the same amount of seed sown.

Density of seeding. With winter sown beds in which growth of seedlings during the growing season is greatest, enough seed should be sown to give a density of not more than 100 seedlings per square foot. In spring sown beds where seedlings are to be transplanted the first fall, a density of 125 to 150 seedlings per square foot will not result in undue crowding. In spring sown beds in which seedlings are to be left for two growing seasons the density should not be more than 60 to 75 per square foot. Fall root pruning in such beds has not yet been tried but this may check growth enough to make greater density possible.

Seedbeds at Berkeley have shown marked failure in a strip about

four inches wide along the north and east sides. This seems to be due to overheating of the top of the soil as a result of the reflection of the afternoon sun from the solid sides of the seedbed frame. This failure has not been evident in beds with wire sides.

FACTOR OF SAFETY IN SOWING

In order to secure approximately the desired density in seedbeds it is necessary to make reasonably accurate allowance for failure of seedlings because of weakness of some seeds, unfavorable weather conditions and other normal causes. Actual germination tests, while more accurate than cutting tests, cannot be used in most cases by men in charge of seeding operations because of the length of time required and the lack of germination apparatus. It has therefore seemed best to determine relation between cutting test and number of trees produced in order that it may be used as a safety factor in sowing seedbeds.

This safety factor as indicated in the following table is quite large, varying from three to seven times the number of seed indicated as viable by the cutting test.

Seed Crop	Where Sown	Cutting Test	Date Sown	Tree Percent	Date	Safety Factor
1920 Santa Cruz	Berkeley	17%	Apr. 5, 1921	3.0	Nov. 1921	.206
1920 Santa Cruz	Berkeley	17%	Apr. 29, 1921	2.3	Nov. 1921	.135
1921 Mendocino Scr. No. 8	Berkeley	28%	Nov. 23, 1921	7.7	Sept. 1922	.276
1921 Mendocino Scr. No. 10	Berkeley	8%	Nov. 23, 1921	2.0	Sept. 1922	.250
1921 Mendocino Scr. No. 10	Berkeley	8%	Feb. 25, 1922	0.09	Sept. 1922	.011
1921 Mendocino Squirrel cache	Berkeley	12%	Feb. 25, 1922	1.0	Sept. 1922	.083
1921 Mendocino 10 yr. old trees	Berkeley	14%	Feb. 25, 1922	Failure		
1921 Santa Cruz Commercial	Fort Bragg	30%	April 1922	6.0	Aug. 1922	.200
1921 Santa Cruz Commercial	Fort Bragg	30%	April 1922	4.0	Mar. 1923	.133
1921 Mendocino young trees	Fort Bragg	1%	April 1922	0.4	Aug. 1922	.400
1921 Mendocino mature trees	Fort Bragg	8%	April 1922	2.6	Aug. 1922	.324
Average Safety Factor						.210

The above figures indicate that on the average only 20% of the seed indicated as viable by cutting test will develop into trees. Therefore in order to secure any desired density it is necessary to sow five times the

number of seed indicated as viable by the cutting test. For example, it is desired to know the number of seed to sow to obtain a density of 100 seedlings per sq. ft. using seed with the following specifications:

No. of seed per pound	125,000
Purity	95%
Cutting test	15%
Safety factor	20%

The probable number of trees per pound may be estimated as follows:

125,000 x .95 x .15 x .20 = 3562 effective seed per lb.

The amount of seed to sow per sq. ft. is therefore $\frac{100}{3562} = 0.028$ lbs. = 0.45 oz.

Early germination of seed of 1922 crop from different localities is summarized in the following table. It should be realized, however, that the tree percent later in the season is usually much lower because of unavoidable losses from drought and similar causes.

GERMINATION OF REDWOOD SEED—1922 CROP

Source of Seed	Where Planted	Date	Cutting Test	Date Examined	Tree Percent
Sonoma Co.	Scotia	Apr. 14, 1923	15%	May 24, 1923	7.1
Contra Costa Co.	Scotia	Apr. 14, 1923	32%	May 24, 1923	19.5
Santa Cruz	Scotia	Apr. 14, 1923	16%	May 24, 1923	8.2
Marin	Scotia	Apr. 14, 1923	37%	May 24, 1923	13.2
Humboldt	Scotia	Apr. 14, 1923	18%	May 24, 1923	14.0
Santa Cruz	Berkeley	Dec. 1, 1922			
		Jan. 15, 1923	22%	June 4, 1923	10.3 Av. of 4
Santa Cruz	Berkeley	Feb. 1, 1923			
		Mar. 15, 1923	22%	June 4, 1923	7.1 Av. of 4
Sonoma	Berkeley	Mar. 12, 1923	11.9	May 31, 1923	1.0*
Contra Costa	Berkeley	Mar. 12, 1923	32	May 31, 1923	2.4*
Santa Cruz	Berkeley	Mar. 12, 1923	32	May 31, 1923	2.0*
Marin	Berkeley	Mar. 12, 1923	37	May 31, 1923	5.9*
Humboldt	Berkeley	Mar. 12, 1923	37	May 31, 1923	9.5*
Mendocino	Berkeley	Mar. 12, 1923	22	May 31, 1923	4.1*

INFLUENCE OF STORAGE ON VIABILITY

The seed of many species of forest trees has such transient vitality that it is useless to save the seed over one growing season in case of a failure of the seed crop the next year. It has thus far been possible to

*The probable reason for the comparatively low tree percent in these tests is that the beds were screened but not shaded as the lath frames were all in use on other beds. These beds were irrigated twice a week but this apparently did not compensate for lack of shade during the germination period.

test only one lot of redwood seeds for retention of vitality. The seed used was the same as that sown at Fort Bragg in April 1922, being 1921 seed from Santa Cruz County. The sample received at Berkeley in Feb. 1922, was placed in bottles and stored in the 26°-30° F. room in the refrigeration plant from June 19, 1922, to Feb. 1, 1923. The cutting and germination tests before and after storage may be summarized as follows:[1]

Screen No.	Cutting Test Feb. 1922	Feb. 1923	Germ. in Sixty Days Feb. 1922	Feb. 1923
8	42%	22%	18.5%	17%
10	16%	18%	10.0%	7%

This seems to indicate that redwood seed retains its vitality remarkably well for one year under refrigerator conditions. After removal there is apparently a very rapid loss in vitality as a cutting test on March 23, 1923, of a sample of the No. 10 seed, showed only 4% viability as against 18% on removal from the refrigerator.

The remainder of this seed was then sown in the nursery with the following results:

STORED SEED IN THE NURSERY

Screen No.	Date of Sowing	Amount of seed Sown	Result June 4 No. of trees	Tree %
8	Feb. 1, 1923	25 gm. = 6350	96	1.5
10	Feb. 1, 1923	15 gm. = 5050	15	0.3
10	Mar. 15, 1923	30 gm. = 9430	152	1.6

The poor showing made by No. 10 seed sown on Feb. 1st, was probably due to some local condition incident to sowing and is more than made up by the results with seed of the same lot sown Mar. 15.

The seedlings while not as sturdy as those from seed of 1922 crop sown on the same date look as if they would make satisfactory growth.

The above results while indicating a considerable loss in vitality during storage, demonstrate that at least moderate success may be expected with seed stored under refrigerator conditions.

TRANSPLANTING

Transplanting redwood seedlings in the Berkeley nursery indicates that where soil and weather conditions are favorable, the losses incident to this operation may be kept below ten percent. The soil here is heavy

[1]Thanks is due Mr. A. Grasovsky for his assistance in carrying out the field work of this test.

adobe with a liberal mixture of coarse stones which makes conditions anything but ideal for transplanting operations. In addition to this handicap it has frequently been necessary to use inexperienced labor and to move the plants during dry, windy weather. Even under these adverse conditions a surprisingly large number of trees have become established which indicates that under optimum conditions the loss can probably be kept below five percent.

The chief difficulty seems to be the small size of many of the seedlings from spring sown seed. Under our conditions these have been so small that planting by hand with a dibble was the only way they could be handled. In warmer, sandy loam soil, trees from spring sown seed will probably be large enough to handle more economically. Davis reports that it was necessary to separate the trees grown from seed sown in April, 1922, into two size classes before transplanting in March, 1923. This speeded up the transplanting work but added about 40 cents per thousand to the cost of the operation. Trees in the "large" size class made up about 25% of the total number.

The following table gives a summary of transplanting work done at Berkeley:

TRANSPLANTING REDWOOD

Seed Sown	Transplanted	Number Trans-planted	Survial Date	Survial %	Remarks
Apr. 5, 1921	Mar. 2, 1922	758	May 29, 1923	80	Some covered by clods
Apr. 5, 1921	Mar. 2, 1922	758	Sept. 21, 1923	70	10% loss during dry season
Apr. 5, 1921	Mar. 2, 1922	758	Nov. 1, 1915	67	This percentage used for planting
No.v 23, 1921	Mar. 8-10, 1923	484	June 5, 1923	38	Conditions poor*
Feb. 25, 1922	Mar. 22, 1923	187	June 6, 1923	82.5	Conditions good†

It will be noted in the first test above, which is the only one for which complete data are available, that besides the 20% loss after transplanting, 10% died during the summer and 3% were discarded as too small for planting. Trees suitable for planting operations constituted only 67% of the total number transplanted. This is not an unusually

*Only the smallest and weakest plants were used here the others being set in plantations. They were dug, bundled and heeled in Jan. 16 and left for seven weeks. Weather during transplanting was dry and windy and work was poorly done.

†Transplanted immediately without heeling in. Weather conditions more favorable and work carefully done.

low percentage of effective trees and with more favorable soil conditions it can probably be increased to 75 or 80% of the trees transplanted.

PLANTATIONS

Planted redwoods of various ages may be seen in many lawns in central and northern California. A few have also been planted in Southern California but they do not make very satisfactory growth unless given large amounts of water. Some of the oldest and finest redwoods in the state are growing in Capitol Park, Sacramento. (See Fig. 7.) All of these originated as natural seedlings in the Santa Cruz mountains. They have had good care and moisture conditions may be considered optimum as the trees are surrounded by lawns which are constantly irrigated.

PLANTED REDWOODS—CAPITOL PARK, SACRAMENTO

Age Years	No. of Trees	Average DBH	Average Height	Mean Annual Growth	
				Diameter	Height
52	*7	38.5	97.	0.74	1.86
44	(x)2	24.5	82.5	0.55	1.87
8	(s)4	11.7	36.	1.45	4.5
7	(a)1	10.0	32	1.0	3.2

What is undoubtedly the oldest plantation of redwood in the state is situated near Chico in Butte County on the Chico Forestry Station. It is therefore growing far from the fogs of its native habitat and for this reason the growth of the trees here is of peculiar interest in showing under what a wide range of climatic conditions this species will grow and thrive. The plantation is situated within 50 yards of the bank of the Big Chico Creek on gravelly loam soil of good quality. Plenty of moisture is available as the water table is always within five feet of the surface of the ground. The trees were planted in 1890 and measured in 1920. A summary of these measurements is given in the following table. The volume calculations assume utilization to a 5 inch top and are computed

*There are in all eight trees of this age. One on the north side had its top blown out about 1908 and was not included in the measurements.

(x) One of these trees is forked at 2 ft. from the ground so that three stems were measured.

(s) These are natural seedlings from Santa Cruz County planted in 1914. Their ages probably vary by one or two years.

(a) A natural seedling collected the same time as (s) but held one year before planting.

according to the volume table for second growth redwood by Bruch which is based on the International Log Scale.

REDWOOD PLANTATION, CHICO, CALIFORNIA

Age ....30 years	Spacing ....16x16 feet
Number planted per acre.....170	Present survival 86%
Average DBH.......15.3 inches	Average height..........67.6 ft.

SEGREGATION OF TREES ACCORDING TO SIZE

Av. ht.	*Largest* 91 ft.	*Medium* 75 ft.	*Smallest* 40 ft.
Av. DBH	24 in.	15 in.	7 in.
Vol. cu. ft.	690	428	35
Vol. bd. ft.	4780	2222	86
Form factor	.26	.33	.38
% total No.	27.3	45.4	27.3
% basal area	59.8	35.4	4.8

PER ACRE FIGURES

Number of trees.......................147
Basal area ....299 sq. ft.
Cubic ft. volume....................5,270
Board ft. volume...................31,400

Mean annual growth bd. ft. per acre = 1047.

This plantation was cultivated but had no irrigation after it was first set out.

The growth in volume in this plantation compares favorably with rapid growing trees of other species and is a very high yield per tree though not so high per acre as some natural stands of redwood of equal age because of the wide spacing. If 225 to 250 trees per acre were present the growth would compare very favorably with some of the better natural second growth stand within the redwood region. (See Fig. 8.)

Stock of several different ages and sizes has been set out in the Berkeley Hills during the last three years. Planting conditions met with here are probably as severe as will be met with on any site in the redwood region proper because of (a) heavy clay adobe soil, (b) low annual rainfall—21-24 inches, (c) severe grass competition, (d) heavy

winds off the ocean, (e) Southeast exposure. About the only favorable factor on this planting site is the prevalence of fogs during the summer which assist materially in reducing loss of moisture from soil and plants. Much of the planting has been done by students in connection with laboratory work and so had to be done often under rather adverse weather conditions. After planting, the trees have had no attention except one cultivation each spring with a grub hoe to remove grass and weeds and provide a mulch of loosened soil around each tree. The results may be summarized as follows:

REDWOOD PLANTATIONS

Strawberry Canyon, Berkeley Hills, Alameda County

Date Planted	Character Stock	Number Planted	Date Examined	Percent Survival	Remarks
Dec. 28, 1920	1-1*	90	May 1921	94%	Shaded by willows
Dec. 28, 1920	1-1	90	Mar. 1922	46%	Average ht. 4″-6″
Dec. 28, 1920	1-1	90	Mar. 1923	46%	Average ht. 13″
Jan. 9, 1922	1-1	48	May 1922	88.8%	Opening in dense brush
		45	Feb. 1923	38%	Some rodent damage
Feb. 4, 1922	1-1	45	Jan. 25, 1923	50%	Dry, grassy southeast slope
Feb. 4, 1922	1-1				
Feb. 22, 1922	1-1	12	Jan. 25, 1923	60%	Small gulley E. slope
Oct. 12, 1922	Wildings	10	Jan. 25, 1923	10%	Sheltered gulley
Oct. 12, 1922	1-1	10	Jan. 25, 1923	30%	Sheltered gulley
Jan. 3, 1923	1-0	33	May 5, 1923	55%	2″-3″ when planted
Jan. 3, 1923	1-0	51	May 5, 1923	67%	3″-5″ when planted
Jan. 9, 1923	2-0	43	May 5, 1923	56%	
Jan. 10, 1923	Wild-1	11	May 5, 1923	100%	Large stock, sheltered gulley
Feb. 6, 1923	Rooted suckers-1	11	May 5, 1923	27%	

On the basis of the above figures it appears safe to count on a survival of 45 to 50 percent when 1-1 stock is used. The best season for planting seems to be from late November to early February depending somewhat on the precipitation during any particular year. A little discoloration from frost has been noted after cold spells in February, 1922, and February, 1923, but apparently no serious injury was caused.

PROTECTION FROM WIND

Observation of many natural and planted redwood trees has led to the conclusion that this species is very easily damaged by strong winds. The best natural stands are invariably found growing in sheltered situations, and the most exposed sites along the coast are usually occupied by pure stands of Sitka spruce. Redwood trees planted in exposed situa-

*Means 1 year in seedbed and 1 year in transplant row.

tions in the San Francisco bay region, Santa Cruz, Monterey and elsewhere, generally have twisted or deformed leaders and make relatively slow growth in height.

Mixed stands of redwood, spruce, Douglas fir and grand fir show that the protection afforded by these associated species enables the redwood to make normal growth in situations where single trees or small exposed groups show deformation by wind. The early height growth of these associated species is somewhat more rapid than redwood and it will probably be desirable to set out mixed plantations of these trees on sites where strong winds are prevalent. Sitka spruce grows very slowly in the nursery and must be very carefully handled to insure success. It is seldom large enough for field planting until it is five or six years old but the value of its wood and its rapidity of growth after becoming well established make it a very desirable but expensive tree to use.

Both Douglas fir and grand fir are easy to handle in the nursery and grow rapidly enough so that 1-1 stock is sturdy enough for planting. Grand fir has shown the lowest transplanting loss of any tree thus far tried in the Berkeley nursery. It grows rapidly both in seedbeds and after transplanting, and therefore deserves consideration in choosing associates for redwood in plantations. Another little known but promising tree for this purpose is the California nutmeg which combines rapidity of growth during early life with ability to sprout vigorously from cut stumps as the redwood does. Nutmeg seedlings have been successfully grown at Berkeley for several years and if field tests are successful this tree may take first rank on certain sites for planting with redwood.

SUMMARY

1. Redwood seed should be collected during October and November from trees between the ages of sixty and two hundred and fifty years, growing on good sites in stands of moderate crown density. The cones will average 227 per pound and approximately 11% of their green weight will be returned as clean, dry seed after extraction.

2. The average pound of clean redwood seed contains 123,000 seed having an indicated viability of 15 percent by cutting test, and a germinative energy of 10-12% in sixty days. Carefully screened seed should contain not more than 5% of foreign matter.

3. The number of trees produced at the end of the growing season by the average lot of seed in nursery beds is one fifth of the number of

viable seed as indicated by cutting test. Therefore a factor of safety of .20 should be used in calculating the number of seed to sow. A density of 75 to 100 trees per square foot is satisfactory for fall sown seed.

4. It is desirable to separate the seed into two size classes and sow these separately.

5. Trees from seed sown in December and January make better growth than those from late sown seed. The latter will usually require a year in transplant rows before planting; about 25 percent of the former should be large enough for planting directly from seedbeds.

6. A loss of 25 to 30 percent of the trees produced in seedbeds should be figured on as a result of transplanting, drought and culling prior to planting.

7. Survival of trees in plantations will vary greatly depending on weather conditions, size and age of stock used, and amount of care used in setting out the trees. It seems safe at the present time to estimate survival under reasonably good conditions at 50 to 75 percent.

8. After becoming established, redwood in plantations makes very rapid and satisfactory growth on good sites.

9. On sites exposed to severe winds it will probably be well to plant a mixture of other fast growing native species with the redwood so that these may prevent damage to redwood tops.

RELATION OF THE QUALITY OF LUMBER PRODUCED TO THE PERCENTAGE OF THE STAND CUT

By Jay H. Price,

U. S. Forest Service

There has been general recognition that the average quality of pine timber obtained from Government sale areas in California is higher than the average quality of similar timber logged under clear cutting methods. In 1915 Swift Berry and J. C. Elliott made a systematic study to measure the amount of the difference in quality produced by the two cutting methods on an area of mixed coniferous timber in the operating zone of the LaMoine Lumber and Trading Company on the Shasta Forest. The results of the study of sugar and western yellow pines are summarized in the following table:

Species	Percent of Total Stand Cut		Average Value per MBM Based on normal (1915) wholesale lumber prices	
	Cutting Methods Forest Service	Company	Cutting Methods Forest Service	Company
Yellow Pine.....	88.6	99.1	$19.18	$18.70
Sugar Pine......	81.0	99.5	20.54	19.40

While this factor in lumber values is ordinarily taken care of in Forest Service stumpage appraisals in California by confining the quality survey to the trees to be marked for cutting, there are occasions when quantitative knowledge of the effect of marking on the lumber quality is essential. It is often necessary to make the quality surveys before the marking limitations imposed by management plans are known and there have been occasions when the marking practice has been changed subsequent to appraisal. In such cases the proper adjustments can be made if the quality factor is isolated and intelligently weighed. It has, in addition, an important relation to the public requirement study, in that the cost of leaving small trees for seed bearing purposes cannot be measured completely without knowing the value of the material produced from such trees.

It is obvious that the effect of marking on lumber quality varies with the type of timber. For this reason several studies are necessary to cover the field thoroughly. As a start upon this work the writer

trial-marked and log-graded the yellow pine on 34 acres in the eastern Lassen region. The strips were selected with the view of obtaining as fair a cross section as possible from a limited acreage of timber on two large sale areas in that region. The stand varied from pure yellow pine to a mixed stand consisting of about 75% yellow pine and 25% white fir and incense cedar. The average stand of yellow pine was 24,400 feet per acre. The site barely qualified as Site III under the standard five site classification. The slopes were gentle with a general westerly exposure.

Each tree was measured and recorded separately under one of five silvicultural classes. Class one consisted of trees of the "black-jack" type only. Class two included the more thrifty trees of the intermediate age classes that were free from injury. Class three covered all other trees showing evidence of being in a fair growing condition and having no serious bole defects. Class four was a selection of the best mature trees, preference being given to those of the smaller diameter classes and to those properly distributed in reference to the trees of Classes one, two and three. Class five covered all the remaining stand and consisted of mature and overmature material of large diameter with a sprinkling of smaller trees with serious defects or lack of vigor.

The percentage of the total stand falling into each class was as follows:

Class 1,	6.2%
2,	7.7%
3,	10.6%
4,	12.5%
5,	63.0%
Total	100.00%

On Plate No. 1 is plotted the total stand in each two-inch diameter class. There is shown also the segregation into silvicultural classes. The curves are smoothed off somewhat from the actual plotted points.

As each tree was measured the logs were graded into one of three classes, as follows:

No. 1 logs: At least 22″ in diameter at small end and capable of cutting 25% clear and select.

No. 2 logs: At least 18″ in diameter at small end and capable of cutting at least 30% No. 2 shop and better.

No. 3 logs: Rough logs and small logs not qualifying under classes No. 1 or No. 2.

By means of mill scale study information, which gives the expected lumber grades for logs of each diameter class and of each grade, the expected lumber grades were computed for each silvicultural class. The results for Class 5 give the expected grades for a 63% cutting, the combined results for Classes 4 and 5 give the expected grades for a 75.5% cutting, and so on to a combination of all silvicultural classes which gives the expected grades for clear cutting. The following table summarizes the results of these calculations:

Expected Grades	63% Cut	75.5% Cut	86.1% Cut	93.8% Cut	100%
1 and 2 Clear	1.59	1.50	1.39	1.31	1.24
C Select	2.60	2.52	2.36	2.23	2.11
D Select	5.33	5.19	4.94	4.74	4.53
3 Clear	1.22	1.11	1.03	.96	.90
1 Shop	7.44	7.07	6.73	6.41	6.09
2 Shop	19.15	18.77	18.45	17.97	17.32
Sub-Total	37.33	36.16	34.90	33.62	32.19
3 Shop	11.10	11.09	11.16	10.91	10.54
1 and 2 Common	7.98	8.44	8.98	9.67	10.68
3 Common	25.26	26.19	26.95	27.73	28.32
4 Common	18.33	18.12	18.01	18.07	18.27
Totals	100.00	100.00	100.00	100.00	100.00

The average lumber value for each marking was calculated on the basis of average 1921-1922-1923 California wholesale selling prices, f. o. b. mill. The following table gives the results:

Percent Cut	Percent Left	Average Value of Lumber Produced
63.0	37.0	$34.61
75.5	24.5	34.21
86.1	13.9	33.73
93.8	6.2	33.28
100.0	0.0	32.86

Plate No. 2 is a graphical presentation of the foregoing data.

While Plate No. 1 shows that diameter is by no means the only consideration in marking, the suggestion has been made that cutting to a diameter limit is a reasonably satisfactory method for timber operators to follow in introducing controlled cutting on their own holdings. It is therefore of interest to study the relative values of lumber produced by trees of different diameters. All of the trees recorded were segregated into two-inch diameter classes, regardless of silvicultural classes, and the average lumber value calculated for each such class. The results are shown on Plate No. 3.

Plate No. 4 is a variation of Plate No. 3 in which the value for each diameter class is expressed as a percentage of the average lumber value of the entire stand. It appears that trees up to and including 20″ in diameter produce lumber of about three-fourths the average value. From 22″ the curve rises to 36″, at which diameter the material produced is of about average quality. Material from trees larger than 36″ is of more than average value.

The University of California and the Forest Service have made several studies of the relative costs of logging and sawing small and large logs. The results of those studies, coupled with the foregoing showing of relative lumber values, raises a considerable doubt as to the profit in logging and manufacturing small trees under present conditions in California. It appears very probable that on many operating areas a reasonable number of small trees can be left without incurring any loss by so doing.

It is proposed to extend the quality study to other types during the current year and to assemble and correlate all the material then available on the relative quality and logging and manufacturing costs of trees of various diameters.

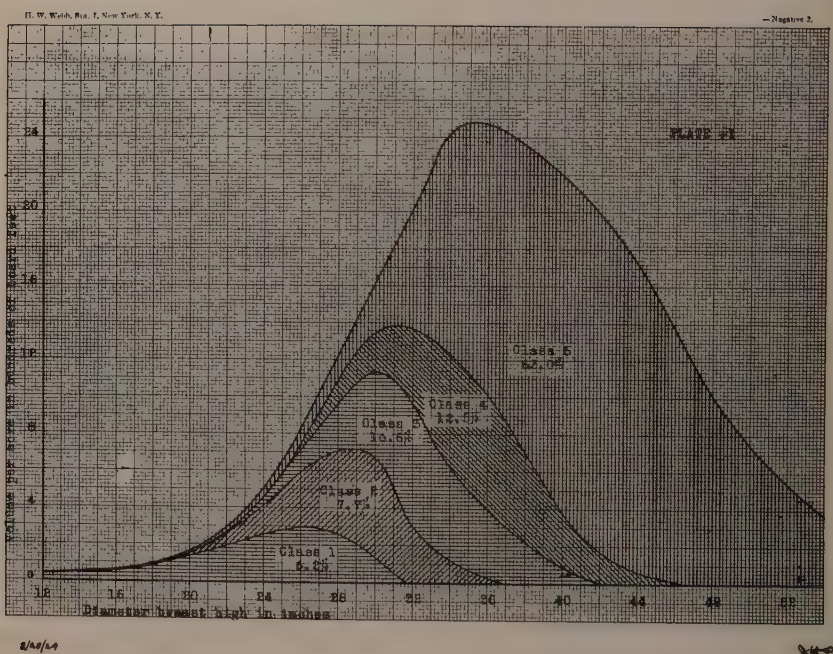
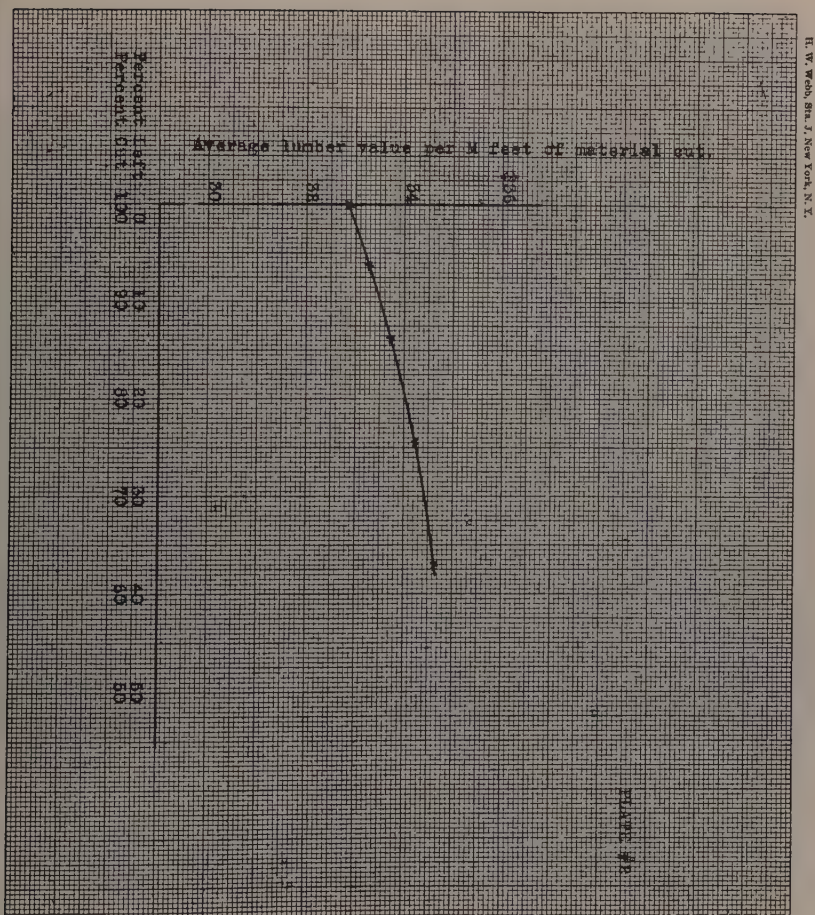


PLATE #1
Class 5
Class 4
Class 3
Class 2
Class 1
0
4
8
12
16
20
24
12
16
20
24
28
32
36
40
44
48
52
Diameter breast high in inches


Average lumber value per M feet of material cut.
30
32
34
$36
Percent Left 0 10 20 30 40 50
Percent Cut 100 90 80 70 60 50
PLATE
H. W. Webb, Sta. J, New York, N. Y.

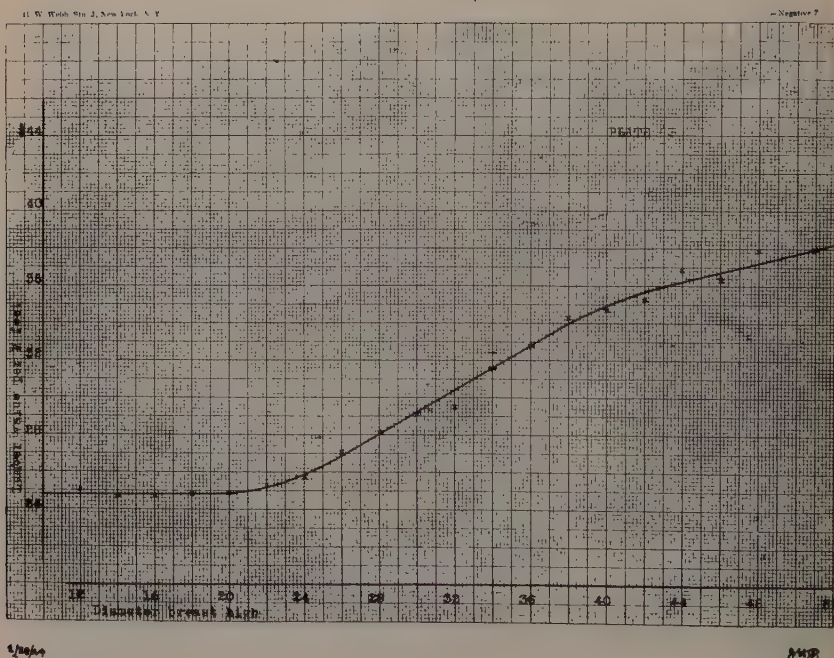
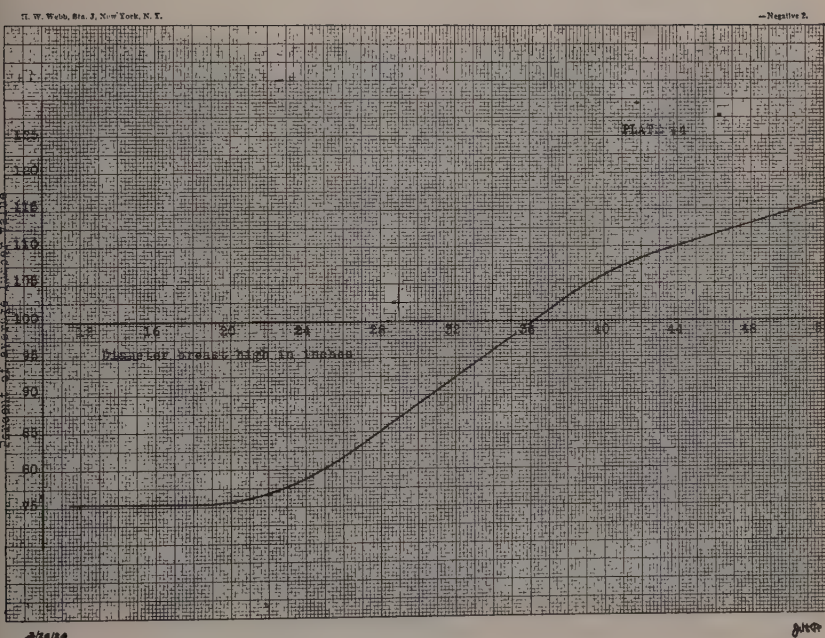


PLATE
40
20
24
28
32
36
40
Diameter Breast High


125
120
115
110
105
100
95
90
85
80
75
12
16
20
24
28
32
36
40
44
48
52
Diameter breast high in inches

THE APPLICATION OF NORMAL YIELD TABLES

By I. T. Haig,

Forest Assistant, Priest River Forest Experiment Station

It is generally recognized that the yields predicted in normal yield tables are not directly applicable to the average stand or forest under present conditions. In the normal yield table for the western white pine type, now being made by the Priest River Forest Experiment Station, the yields are based on the measurement of carefully selected sample plots in healthy stands, neither visibly over nor understocked. They are not representative of the average yield to be expected over large areas, in which the free play of natural influences has caused blanks, thin places and perhaps in many cases overcrowding in the forest canopy. It is necessary, therefore, to determine a method of applying the normal yield table.

Several methods of applying normal yield tables have been used by foresters in America. The most common practice, perhaps, is that of roughly discounting normal yield in the light of figures of actual yield resulting from timber cruises, and frequently normal yield tables are not used at all, but dependence is placed entirely upon empirical yields. Another practice is that of reducing the normal yield on the basis of actual stocking. For example, if the actual stand at 20 years is found to be 25 per cent understocked by basal area as compared to the normal, it is assumed it will be 25 per cent understocked at, let us say, 100 years. None of these methods has proved entirely satisfactory for practical use.

This lack of definite knowledge as to the application of normal yield tables is unfortunate, and it is the purpose of a study at present under way to determine for the western white pine type (*Pinus monticola*) a correction factor that will permit the application of normal yield tables to actual stands. The information resulting from the study will furnish also an excellent basis for a better understanding of the relative difficulties of making and using normal and empirical yield tables.

THE PROBLEM

In stands near rotation age the prediction of yields at time of cutting is comparatively simple. For example, if the stand is 25 per cent under normal, by basal area or some similar factor, it is reasonable to expect that for short periods this particular relation will continue to hold true. If a more accurate prediction is necessary, it can be obtained by a study of current growth. But with young stands the

problem is more difficult. It is believed by many foresters that young stands, under or overstocked, tend toward normality, and within certain limits often reach normality at maturity. If this is true, the relation between trees per acre, basal area, or some similar factor, for a twenty-year-old stand, and the same factor for normal stands of similar age, tells us little of what this relation will be at the age of cutting, 80 or 100 years away. It appears that we must be able to define the limits of normality and particularly to predict the tendency toward normality before future yields for young stands can be forecast with accuracy.

In addition to the adjustment needed due to abnormal (over or under) stocking, there are two other factors affecting the use of normal yield tables which should be mentioned. First, reduction is sometimes necessary due to permanent blanks in the type too small to map. It is believed that this factor in the case of the western white pine type is unimportant enough to be ignored. A second factor, the reduction of final yields due to rot, breakage, and similar factors can best be adjusted by allowing a cull per cent based on experience, just as figures from standard volume tables are reduced under similar conditions. It is not necessary to consider cull within the yield table itself.

The essential problem, therefore, particularly for young stands, is a prediction of the changes in stands due to the apparent tendency toward normality of abnormal stands. In any attempt to compare the present relation of actual stands with the normal, and to predict the tendency toward normality, each of the following factors should be considered as a possible basis:

(1) Number of trees per acre.
(2) Number of dominants.
(3) Basal area.
(4) Volume.
(5) Current growth.

It will be necessary to obtain these data for all natural variations in stocking in the type in order to follow the tendency of stands of various degrees of stocking—at least within wide limits. These data can be secured as follows:

(1) By repeated measurements of permanent sample plots of all degrees of stocking—within reasonable limits. This would be the most accurate, for stands could then be followed through to maturity and the tendency toward normality actually measured. With this

method the data would not become available until the stands were mature.

(2) By simultaneous installation of temporary plots (or strip cruises) in all degrees of stocking and various age classes up to and including rotation age. This method possesses a material advantage in that the facts are available for immediate use. This plan will be followed in the present study, particularly as time and money are not available for the installation and remeasurement of permanent plots. A few permanent plots in understocked and overstocked stands of young age classes will, however, be installed as suitable conditions are found in the course of the work.

The field data needed in this study, therefore, are an inventory of stands and certain additional facts on growth, representing the condition of stands over large areas at various ages. A sufficiently large number of temporary plots must be measured in various age classes, so that these will embrace the entire range of stocking in each age class. With the data available from these plots, for each site, or an average of sites, graphic methods can be employed to divide the total range of stocking into groups.

Using the abscissa of cross section paper to represent age in years and the ordinate to represent basal area (or trees per acre, or any of the other factors previously mentioned), basal area by plots may be plotted. Lines can then be drawn through the points representing the upper and lower limits of the range in stocking for each age class. The space between these limiting lines may thereupon be arbitrarily divided into several spaces of equal magnitude by means of inside curves, equidistant within the upper and lower limit curves.

Let us suppose, for example, that two such inside curves are described. The plots are now separated into three arbitrary equal-sized groups. Each group is thus representative of a certain relative degree of stocking. Group I might be termed heavy stocking, Group II medium stocking, and Group III light stocking. The limits of each group are fixed at various ages by the dividing lines of the graph. Now for each of these groups the average yield at various ages can be determined. This average yield is the basis for the correction factor which we are seeking. If the average yield of Group III is found to be 50 per cent normal at 20 years and 75 per cent normal at 100 years, then the correction factor for Group III at 100 years is .75, rather than .50. It is reasonable to suppose that stands containing similar

stocking will show a similar trend and if the required information, basal area, trees per acre, or whatever factor proves applicable, is obtained for a 20-year-old stand and this stand proves to have Group III stocking, then the yield at 100 years will be the normal yield multiplied by .75 (the correction factor).

Similar correction factors can be worked out for other degrees or ranges of stocking and for various ages. These correction factors may possibly be arranged by age classes in a final table somewhat like the following. In this way the yields read from normal tables can be corrected for various degrees of stocking, permitting the use of a normal table in the prediction of growth and yield in other than fully stocked stands.

Correction Factors° For Normal Yield Table Based on Basal Area

Age of Stand in Years										
20	30	40	50	60	70	80	90	100	110	120
Per Cent of Normal—Lightly Stocked Stands										
25	28	32	37	42	45	48	52	55	58	60
50	54	58	61	64	67	70	72	73	74	75
75	79	83	85	87	90	93	96	98	100	100
Normally Stocked Stands										
100	100	100	100	100	100	100	100	100	100	100
Per Cent of Normal—Heavily Stocked Stands										
125	122	119	116	113	110	107	105	103	102	100
150	140	135	130	125	120	115	110	105	103	100
175	160	150	140	130	120	110	100	100	100	100

°The figures in this table, of course, are entirely theoretical and are given simply for purposes of illustration. It might be best to use a decimal point rather than per cent, e. g., .25 instead of 25 per cent.

It is realized that difficulties may be encountered in securing data representative of the range in stocking typical of the western white pine type. It may prove difficult to set reasonable upper and lower limits for this range, and to secure enough plots to give reliable averages in each group of stocking. For this reason it is planned to confine the field work in the present study to a few, possibly four, age classes. It should also be mentioned that while the method just outlined for analyzing the data is the main lead to be followed, other possibilities need not be overlooked. Current growth in particular opens an interesting field and its application in the determination of yield of abnormally stocked stands will be carefully studied.

The possibility of obtaining the necessary data from previous work has been considered. There are two possible sources:

(1) European data:—the intensive methods used in Europe, including planting and thinning, make it improbable that data covering a wide degree of stocking could be obtained. In addition, the tendency of stands towards normality depends largely on growth. This would prohibit the use of European data, and practically confine us to figures on the western white pine type.

(2) Previous work in the white pine type. It may be possible to use some of the data gathered in previous studies. Although a great deal of material from reconnaissance and empirical studies is also available, the accuracy of most of this is so doubtful as to preclude its applicability. In this latter work, too, certain facts are lacking, particularly accurate data on age and growth. The earlier investigative work, however, should furnish a number of overstocked plots.

FIELD WORK

Enough temporary plots in representative age classes must be measured to obtain typical stocking and range of stocking for the white pine type. Probably several hundred plots will be necessary. These plots should be of small area, $\frac{1}{8}$ to $\frac{1}{4}$ acre, as the total number of plots will be of more importance than the acreage covered. They will be mechanically distributed over an area, but this distribution must be tempered by the application of judgment and proposed plots abandoned or extra plots taken as this appears to be of obvious benefit. A stand table of current growth and height measurements will be obtained for each plot. The shape of the plots must be standard, i. e., the boundaries should not be meandered, although the plots can be either circular or rectangular in shape as best suits local conditions. The records will include a description of the plot, the crown density, age, and general condition. The trees will be recorded by crown class. Heights will be obtained with an Abney level. Diameters will be taken with a tape, or with calipers in the older age classes. A number of borings to determine current growth will be made on each plot.

The office work will consist of a thorough analysis of all data of possible applicability in this study. The growth of abnormal stands will be compared as accurately as possible with the growth of normal stands, and an attempt made to predict any tendency toward normality. If this tendency can be determined, numerical correction factors will be computed and used for determining the yield of stands which differ from the normal.

PATRICK MATTHEW, THE FORESTER

Author of Naval Timber and Arboriculture, in Which He Propounded the Theory of Evolution in the Year 1831

By Dr. John C. Gifford

The following has been reprinted from an old book to render it available to those who might be interested. The name of the book is "Naval Timber and Arboriculture," by Patrick Matthew, a forester. The book was printed in Scotland and England in 1831.

Mr. Matthew believed the only way to have peace throughout the world was by means of Universal Empire. One powerful but just people must rule the world and of course the British Empire was his choice. It is only on the ocean that this power could ever be attained. This required a great navy and since steel was not used in ship building at that time, Mr. Matthew felt that there could be no more important or patriotic occupation for man than the production of suitable timber for ship construction. The importance of the forester, for that reason, loomed big in his mind. No doubt some of the finest oak forests in England were planted with that in view. It is of interest to note in this connection that the first reservations in the U. S. were live oak forests on the Gulf Coast set aside by the Government for the use of the Navy. Aside from its interest in forestry, naval construction and the extension of the British Empire, Mr. Matthew antedates, in the theory of evolution in the appendix of this book, both Darwin and Wallace by many years. This is put in small space at the end of the book with other subjects and of this Darwin himself wrote as follows: "I freely acknowledge that Mr. Matthew has anticipated by many years the explanation which I have offered of the origin of species under the name of natural selection. I think that no one will feel surprised that neither I, nor apparently any other naturalist, had heard of Mr. Matthew's views, considering how briefly they are given and that they appeared in the appendix to a work on "Naval Timber and Arboriculture."

Having read the above letter in the North American Review, I began a hunt for the above book and found it in England. The book contains 391 pages, the last eight of which are copied below. It has often been said that the theory of evolution is very old and that Darwin and Wallace merely brought it to light in such a brilliant manner that

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*Since writing the above it has been called to my attention that Raphael Zon of the U. S. Forest Service and editor of this Journal in an able and complete article in The American Naturalist, Vol. XLVII, Sept., 1913, entitled "Darwinism in Forestry," refers to the work of Patrick Matthew and the relations of forestry to the law of evolution in an abler and fuller way than I have done. It is good, however, to keep the subject alive and to reprint the words of Matthew in full on this subject.—J. C. G.

the general public took hold of it, either pro or con, in a serious way. Well known men still find it a fruitful subject for talk, although to a scientist it is like arguing the wetness of water or the brightness of sunshine. The fact that the subject is so well put in this book, considering the time of its publication, and that the man who wrote it was a *forester,* I have felt that a reprint of it for the convenience of those who may not be able to see the original, well worth while. Science has killed many superstitions and will continue to kill more and, as Louis Pasteur once said, "Take interest, I implore you in those sacred dwellings which one designates by the expressive term: *Laboratories.* Demand that they be multiplied, that they be adorned; these are the temples of the future—temples of well-being and of happiness. There it is that humanity grows greater, stronger, better."

The forest is the forester's laboratory. In the Tropics, especially, it is biologic headquarters. The forester's work is mainly in guiding the struggle between species, acting himself as a biologic factor in helping the most fit for man's purpose to survive and in finding and favoring the kinds best fitted to any particular environment. It is quite fitting, therefore, that a forester, who is most familiar with all the forces, good and bad, working within the forest, should be among the first, if not the first, to explain the origin of species, natural selection, survival of the fittest, and all that goes with the great law, commonly called the theory of evolution.

"Throughout this volume, we have felt considerable inconvenience, from the adopted dogmatical classification of plants, and have all along been floundering between species and variety, which certainly, under culture, soften into each other. A particular conformity, each after its own kind, when in a state of nature, termed species, no doubt exists to a considerable degree. This conformity has existed during the last forty centuries. Geologists discover a like particular conformity—fossil species—through the deep deposition of each great epoch, but they also discover an almost complete difference to exist between the species or stamp of life, of one epoch from that of every other. We are therefore led to admit, either of a repeated miraculous creation; or of a power of change, under a change of circumstances, to belong to living organized matter, or rather to the congeres of inferior life, which appears to form superior. The derangements and changes in organized existence, induced by a change of circumstance from the interference of man, affording us proof of the plastic quality of superior life, and the likelihood that circumstances have been very different in the different epochs, though steady in each, tend strongly to heighten the probability of the latter theory.

"When we view the immense calcareous and bituminous formations principally from the waters and atmosphere, and consider the oxida-

tions and depositions which have taken place, either gradually, or during some of the great convulsions, it appears at least probable, that the liquid elements containing life have varied considerably at different times in composition and in weight; that our atmosphere has contained a much greater proportion of carbonic acid or oxygen; and our waters, aided by excess of carbonic acid, and greater heat resulting from greater density of atmosphere, have contained a greater quantity of lime and other mineral solutions. Is the inference then unphilosophic, that living things which are proved to have a circumstance-suiting power—a very slight change of circumstance by culture inducing a corresponding change of character—may have gradually accommodated themselves to the variations of the elements containing them, and, without new creation, have presented the diverging changeable phenomena of past and present organized existence.

"The destructive liquid currents, before which the hardest mountains have been swept and comminuted into gravel, sand and mud, which intervened between and divided these epochs, probably extending over the whole surface of the globe, and destroying nearly all living things, must have reduced existence so much, that an unoccupied field would be formed for new diverging ramifications of life, which, from the connected sexual system of vegetables, and the natural instincts of animals to herd and combine with their own kind, would fall into specific groups, these remnants, in the course of time, moulding and accommodating their being anew to the change of circumstances, and to every possible means of subsistence, and the millions of ages of regularity which appear to have followed between the epochs, probably after this accommodation was completed, affording fossil deposit of regular specific character.

"There are only two probable ways of change—the above, and the still wider deviation from present occurrence—of indestructible or molecular life (which seems to resolve itself into powers of attraction and repulsion under mathematical figure and regulation, bearing a slight systematic similitude to the great aggregations of matter), gradually uniting and developing itself into new circumstance-suited living aggregates, without the presence of any mould or germ of former aggregates, but this scarcely differs from new creation, only it forms a portion of a continued scheme or system.

"In endeavoring to trace, in the former way, the principle of these changes of fashion which have taken place in the domiciles of life, the following questions occur: Do they arise from admixture of species nearly allied producing intermediate species? Are they *the diverging ramifications* of the living principle under modification of circumstance? Or have they resulted from the combined agency of both? Is there only one living principle? Does organized existence, and perhaps all material existence, consist of one Proteus principle of life capable of gradual circumstance-suited modifications and aggregations, without bound under the solvent or motion-giving principle, heat or light? There is more beauty and unity of design in this continual balancing of

life to circumstance, and greater conformity to those dispositions of nature which are manifest to us, than in total destruction and new creation. It is improbable that much of this diversification is owing to commixture of species nearly allied, all change by this appears very limited, and confined within the bounds of what is called Species; the progeny of the same parents, under great difference of circumstance, might, in several generations, even become distinct species, incapable of co-reproduction.

"The self-regulating adaptive disposition of organized life may, in part, be traced to the extreme fecundity of Nature, who, as before stated, has, in all the varieties of her offspring, a prolific power much beyond (in many cases a thousandfold) what is necessary to fill up the vacancies caused by senile decay. As the field of existence is limited and pre-occupied, it is only the hardier, more robust, better suited to circumstance individuals, who are able to struggle forward to maturity, these inhabiting only the situations to which they have superior adaptation and greater power of occupancy than any other kind; the weaker, less circumstance-suited, being prematurely destroyed. This principle is in constant action, it regulates the colour, the figure, the capacities, and instincts; those individuals of each species, whose colour and covering are best suited to concealment or protection from enemies, or defence from vicissitude and inclemencies of climate, whose figure is best accommodated to health, strength, defence, and support; whose capacities and instincts can best regulate the physical energies to self-advantage according to circumstances—in such immense waste of primary and youthful life, *those* only come forward to maturity from the strict ordeal by which Nature tests their adaptation to her standard of perfection and fitness to continue their kind by reproduction.

"From the unremitting operation of this law acting in concert with the tendency which the progeny have to take the more particular qualities of the parents, together with the connected sexual system in vegetables, and instinctive limitation to its own kind in animals, a considerable uniformity of figure, colour, and character, is induced, constituting species; the breed gradually acquiring the very best possible adaptation of these to its condition which it is susceptible of, and when alteration of circumstance occurs, thus changing in character to suit these as far as its nature is susceptible of change.

"This circumstance-adaptive law, operating upon the slight but continued natural disposition to sport in the progeny (seedling variety), does not preclude the supposed influence which volition or sensation may have over the configuration of the body. To examine into the disposition to sport in the progeny, even when there is only one parent, as in many vegetables, and to investigate how much variation is modified by the mind or nervous sensation of the parents, or of the living thing itself during its progress to maturity; how far it depends upon external circumstance, and how far on the will, irritability and muscular exertion, is open to examination and experiment. In the first place, we ought to investigate its dependency upon the preceding links of the particular

chain of life, variety being often merely types or approximations of former parentage; thence the variation of the family, as well as of the individual, must be embraced by our experiments.

"This continuation of family type, not broken by casual particular aberration, is mental as well as corporeal, and is exemplified in many of the dispositions or instincts of particular races of men. These innate or continuous ideas or habits, seem proportionally greater in the insect tribes, those especially of shorter revolution; and forming an abiding memory, may resolve much of the enigma of instinct, and the foreknowledge which these tribes have of what is necessary to completing their round of life, reducing this to knowledge, or impressions and habits, acquired by a long experience. This greater continuity of existence, or rather continuity of perceptions and impressions, in insects, is highly probable; it is even difficult in some to ascertain the particular stops when each individuality commences, under the different phases of egg, larva, pupa, or if much consciousness of individuality exists. The continuation of reproduction for several generations by the females alone in some of these tribes, tends to the probability of the greater continuity of existence, and the sub-divisions of life by cuttings, at any rate must stagger the advocate of individuality.

"Among the millions of *specific varieties* of living things which occupy the humid portion of the surface of our planet, as far back as can be traced there does not appear, with the exception of man, to have been any particular engrossing race, but a pretty fair balance of powers of occupancy—or rather, most wonderful variation of circumstance parallel to the nature of every species, as if circumstance and species had grown up together. There are indeed several races which have threatened ascendency in some particular regions, but it is man alone from whom any general imminent danger to the existence of his brethren is to be dreaded.

"As far back as history reaches, man had already had considerable influence, and had made encroachments upon his fellow denizens, probably occasioning the destruction of many species, and the production and continuation of a number of varieties or even species, which he found more suited to supply his wants, but which from the infirmity of their condition—not having undergone selection by the law of nature, of which we have spoken—cannot maintain their ground without his culture and protection.

"It is, however, only in the present age that man has begun to reap the fruits of his tedious education, and has proven how much 'knowledge is power.' He has now acquired a dominion over the material world, and a consequent power of increase, so as to render it probable that the whole surface of the earth may soon be overrun by this engrossing anomaly, to the annihilation of every wonderful and beautiful variety of animated existence, which does not administer to his wants principally as laboratories of preparation to befit crude elemental matter for assimilation by his organs."

REVIEWS

Anatomical Notes on Indian Trees, By Ryozo Kanehira. Bulletin 4, Department of Forestry, Taihoku, Formosa, 40 pages, 1 plate. 1924.

The object of this bulletin is "to compare the anatomical characters of Indian woods with those of Formosa, and also to give some aid towards the identification of the sundry woods imported by Japan from India."

Part I contains brief anatomical descriptions of 105 species from 76 genera and 34 families. The following description of *Shorea robusta* is an example: "Number of pores per square mm. 7-10, their diameter 150-280 μ, tyloses present. Wood fibres 14-16 μ in diameter, length 1,000-1,800 μ, wall 6-7 μ thick. Wood parenchyma paratracheal and scattered. Vertical resin ducts present in tangential lines. Pith rays nearly homogeneous, 1-4 cells wide, up to 2 mm. high." The descriptions are based on a study of a limited number of small specimens, which "may not have been taken from representative trees." It seems to the reviewer, therefore, that the painstaking measurements of structural elements were hardly justified inasmuch as many species are subject to wide structural variations. This basis should be kept in mind in using the key in Part II.

Part II is devoted to a painstakingly prepared key based on anatomical characters.

Part III includes lists of the woods in which occur flavone; the woods whose water extraction exhibit fluorescence; the woods possessing ripple marks, and intercellular canals, etc.

Identification of Philippine Woods, By Anatomical Characters, By Ryozo Kanehira, Government Research Institute, Taihoku, Formosa. 70 pages, 2 plates. 1924.

This bulletin embraces the result of an investigation of the anatomical characters of some Philippine woods. The specimens studied were obtained from the Bureau of Forestry at Manila and should therefore be of authentic identity. The species studied number 155, representing 108 genera and 41 families of dicotyledons and 5 species and 4 genera of gymnosperms. In view of the growing importance of Philippine woods in the hardwood markets of the United States this work is a particularly valuable addition to the literature on such woods.

Part I deals with the anatomical characters of each species, the study and description for each being as detailed and in the same form

as indicated in the review, in this number of the Journal, of the same author's bulletin on Indian Woods.

Part II presents a key to the 155 species based on the anatomical characters given in Part I. The arrangement of the key is very logical, but to use it one would have to make an almost minute examination of many of the species, down to measurements of pore diameters and fibre wall thicknesses. The study is evidently based on but few specimens of each species. Because of the great variation in anatomical characters in individual species, the user of the key should bear in mind the basis of the key. The author places Toona and Pterocarpus among the diffuse-porous woods whereas Foxworthy puts them in the ring-porous group. This difference is, likely, solely due to the small number of specimens studied.

In Part III are further classifications based on flavone derivatives, fluorescence, ripple marks, inter-cellular canals, etc. The grouping here is, in several cases, by arbitrary classes. It would have been helpful if the names of the species falling into each class had been given with each table.

The two plates following Part III contain excellent reproductions of photomicrographs of 12 species in cross section.

Monograph of the Mistletoe, By K. von Tubeuf. R. Oldenbourg, Munich and Berlin, 1923.

There is hardly a European plant, aside from those of economic value, which can be compared to mistletoe for the interest this tree parasite has commanded and held from early ages on to the present day. In folk-lore as well as in the philosophic literature of antiquity mistletoe plays a prominent role. Theophrastus, in the fourth century B. C., had a clear concept of the parasitism of mistletoe and was well aware of the peculiar mode of its dissemination. Since his time the literature on mistletoe has grown to immense proportions.

Tubeuf, the well known son-in-law of Robert Hartig whom he followed 20 years ago in the chair of Forest Pathology at the University of Munich, has given us the last word on the European mistletoe, *Viscum album.* His monograph, a volume of 832 pages with numerous illustrations and maps, discusses the subject exhaustively from the point of view of the historian, the botanist, the pathologist and the forester.

The close relationship which exists between the European Viscum and our own Phoradendron with its many species makes Tubeuf's work particularly valuable on this side of the ocean. Botanically the two

genera are very closely related. The type of injury to the tree and of economic loss in timber is the same for both. That the loss is far from being negligible is shown for instance by reports from the Black Forest and Alsace where cull on account of mistletoe in silver fir often amounts to 10 to 15 and even 22%. Tubeuf discusses the difficulties connected with control of the parasite. It is interesting to note that Europe is not free from the well-meaning enthusiast who, under the slogan of conservation and preservation of wild plant life, opposes rational control measures in the forest as well as in orchards in spite of the fact that the broad-leaf race of *Viscum album* causes very serious damage to apple trees.

Tubeuf's volume represents a fine piece of bookmaking in keeping with the old-established reputation of the publishing firm, R. Oldenbourg. Paper and print are far superior to most of the books arriving today from the German market. Both illustrations and maps are excellent. This monumental and scholarly work with its wealth of information should be in the library of every school of forestry, plant pathology and botany.

An Introduction to the Mathematical Analysis of Statistics, By C. H. Forsyth, Asst. Professor of Mathematics, Dartmouth College, pp. 237. John Wiley & Sons, New York, 1924.

During the past year there appeared several articles in the Journal of Forestry dealing with the application of statistical methods to problems in forest mensuration. Not only forest mensuration but other branches of forestry, such as time studies in logging and sawmilling, machine performances, and studies in seed germination, lend themselves well to mathematical analyses. Statistical science is rather late in being recognized in forestry, for most students have long had use for it in their work in economics or engineering and have thus learned of its possibilities. The great mass of data necessary for studies in growth of trees, the mechanical properties of their woods, etc., would be difficult to interpret intelligently without some means of organizing it mathematically.

Professor Forsyth's book should be of assistance to those foresters who are interested in the application of statistical science to forest studies and who wish first to become familiar with the mathematical basis of the principles involved. "Although a knowledge of the calculus is necessary for the proper appreciation of the various principles treated here, the applications are carefully restricted for the most part to those

that do not require the calculus." There are 10 chapters with the following headings: "Errors and Numerical Computation; Finite Differences; Interpolation; Gamma and Beta Functions; Probability; Averages and Aids in Their Computation; Moments; The Normal Curve; The Binomial; Correlation Theory." With each chapter are exercises, covering many fields, for the application of the principles worked out. For example, in the chapter on "The Normal Curve," under least squares and probable errors, there are problems in physics, hydraulics, athletic records, tree measurements, artillery, medicine, etc. The sum total of the chapters is an elucidation of the mathematics of the mechanisms available for the simplification and analysis of masses of data. No matter how many mechanisms are studied, however, the student should be careful to avoid the pitfalls that have already ensnared foresters, chief of which have been insufficient basic data and weak distribution. Furthermore, statistical methods should not be resorted to to bolster up such insufficient data; although if properly used they should reveal the points of weakness in meagre data. In this connection the article on the probable error in a single observation in chapter 9 should be noted.

American Logging and Sawmill Safety Code. Handbook Series of the Bureau of Standards, No. 5. 140 pages, 58 figures. Washington, D. C., 1924.

"This code applies to all logging operations, including transportation of logs to the mill; to the ordinary sawmill operations, including lath and shingle manufacture; to dry kilns and yard operations." The manufacture of veneer and cooperage stock is excluded. The code gives specifications for materials going into the pieces of equipment used by woods and mill workers, points out precautions and lays down rules for their care, handling, and operation and presents many suggestions all intended to provide greater safety for operatives. The code is one of a series of National Safety Codes, formulation of which was recommended by the American Engineering Standards Committee. It is an aggregation of standards which are an invaluable guide to individual companies or State Accident Prevention Commissions in formulating codes adapted to their local conditions.

The following section titles indicate how thoroughly the many operations in the lumber industry are covered: Felling, skidding, loading, donkey engines and boilers, railroads, train operation, river driving and fluming, explosives, sawmill design and layout, log handling, sawing ma-

chinery, live rolls, edgers, trimmers, conveyors, dry kilns, lumber handling machinery, etc.

The rules and precautions and the reasons for them are clarified in a separate portion of the handbook, and many half tones and diagrams are distributed through the text.

The Barometer as the Foot Rule of the Air, By P. R. Jameson, F. R. Met. Soc. 23 pages. Published by Taylor Instrument Companies, Rochester, N. Y., 1915. 15 cents.

This is not a new publication, but it is called to the attention of those foresters who have occasion to use the aneroid barometer in surveys, or who are teachers and have not found a satisfactory simple text for the use of students. This pamphlet, in an exceptionally simple and clear conversational style, gives the laws of atmospheric pressure, the principle of the aneroid barometer and how it should be used in surveys. Having a clear idea of what the aneroid can and cannot do, the student is certain to gain more respect for it. The reviewer uses this pamphlet as a reference for student use and finds that it overcomes very largely a prejudice against the instrument—a prejudice usually based on thoughtless condemnation heard from others who have likely not inquired into the principles involved in measuring altitudes by observing atmospheric pressure.

Report of the Royal Commission on Pulpwood, Canada, Sessional Paper 310. By F. A. Acland, King's Printer, Ottawa, 1924. Page 292.

The inquiry upon which this report is based was undertaken by authority of an Order in Council, dated August 14, 1923. The instructions to the Commission were to investigate the pulpwood situation in Canada with reference to certain specified points, as follows:

1. Total supplies of wood, suitable for pulp, in each Province.
2. Quantity of pulpwood on lands owned by Provincial Governments and by the Dominion.
3. Quantity of pulpwood on other lands, showing whether held by ownership or lease, and whether by Canadian citizens or by aliens.
4. Amount of pulpwood produced in each Province during the past ten years, showing portion used in Canada and that exported.
5. The question of embargo or other restriction of exports of pulpwood.
6. In connection with "5," matters of production, manufacture or sale of pulpwood that were pertinent.

7. Recommendations as to measures needed for better conservation of supplies from standpoint of present and future use.

The data in the report were secured from information already in the hands of various agencies and from hearings held in the various Provinces, similar to those held by our Senate Committee.

Part I deals with the timber resources of all the Provinces that are now or are expected to be of importance in furnishing supplies, i. e., Nova Scotia, New Brunswick, Quebec, Ontario, Manitoba, Saskatchewan, Alberta and British Columbia.

A table (Table I) is given, summarizing the resources of the Dominion by Provinces. Some of the salient points of this table are as follows:

1. Net land area of Provinces named above....2,174,520 sq. mi.
2. Agricultural area of Provinces named above.. 428,893 sq. mi.
3. Barren land area of Provinces named above.. 529,219 sq. mi.
4. Forest area, merchantable and accessible.... 440,660 sq. mi.
5. Forest area, unmerchantable and inaccessible 775,748 sq. mi.
6. Unalienated forest area.................. 972,744 sq. mi.
7. Leased or licensed forest area............ 148,188 sq. mi.
8. Privately owned forest area............... 95,476 sq. mi.
9. Saw timber, softwoods..............441,070,710 M. B. M.
10. Saw timber, hardwoods............. 42,709,500 M. B. M.
11. Pulpwood resources:
    a. Spruce .... 551,564,000 cords
    b. Balsam .... 210,743,000 cords
    c. Hemlock .... 113,287,000 cords
    d. Jack pine and lodgepole.............. 252,136,180 cords
    e. Poplar ....290,300,466 cords
    f. Total pulpwood ....1,418,030,646 cords
    g. Total pulpwood available under present conditions .... 630,250,000 cords
    h. Total spruce, balsam and hemlock now available .... 436,200,000 cords
12. Ownership of pulpwood supplies:
    a. Unalienated .... 863,668,390 cords
    b. Licensed or leased.................. 442,103,373 cords
    c. Privately owned .... 112,231,883 cords

The figures for saw timber and pulpwood overlap, those for saw timber covering only material large enough for saw logs and those for

pulpwood including the total saw timber volume as well as the smaller material.

Under present practice, spruce and balsam supply 93% of total consumption; hemlock, jack pine and poplar, 6¾%; and all other species together only ¼%.

In total amount available under present conditions, Quebec, British Columbia and Ontario are far in the lead in the order named.

Then follows a detailed discussion of the situation in each Province as to total pulpwood resources, provincial control of resources, manufacture and exports, ownership of timber lands and pulpwood resources, consumption of timber, extent of pulp and saw timber industries, trend of pulpwood business, summary of situation and duration of supplies, federal control of exports, where it exists.

Part I ends with a summary of the above items for Canada as a whole. The ownership of available pulpwood is distributed thus, unalienated—27.8%, licensed or leased—55.7%, privately owned—16.5%. The total consumption by Canadian mills for the ten years, 1913-22, was 20,118,550 cords. The total exports rose from 842,308 cords in 1908 to 1,384,230 cords in 1923. The percentage of exports in total production has decreased greatly, i. e., from 63.6% in 1908 to 25.8% in 1922. In 1922, the total production was 3,923,940 cords. The average annual utilization of pulpwood species *for all purposes* is now 6,910,000 cords.

In order to emphasize the importance of the forests, tables are given, showing the total consumption of wood for all purposes and the values of wood products. The total value of the production from all manufactories in which wood is the essential raw material is placed at $400,000,000 annually, giving forest industries second rank in value of production. Only agriculture exceeds it. About 100,000 persons are employed in logging, sawmills, and pulp and paper mills. Invested capital in these lines is close to $600,000,000.

Only five Provinces contain pulp mills. The value of the pulp and paper output is over $140,000,000 annually. About 50,000 persons are given employment in mills and woods with an annual wage bill of $55,000,000-$60,000,000. Production of wood-pulp has increased tremendously, rising from 363,079 tons in 1908 to 2,150,251 tons in 1922. Of this, Quebec produces 50.6%, Ontario, 33.8%, British Columbia, 9.2%. Paper production in 1922 reached 1,366,815 tons.

In 1922, 80% of exports in pulp and 87% of paper exports went to the United States with an aggregate value of $98,000,000. If pulpwood is added, value of total exports to United States was $108,400,000.

During the period for which reliable figures are available (1908-1922), lumber production reached its peak in 1911 with a cut of 4.92 billion board feet. Since that year, the cut has fluctuated considerably, amounting in 1922 to only 3.14 billion feet. Throughout the period, spruce led all other species with 34.7% of total lumber produced. Douglas fir furnished 19%, white pine, 18%, hemlock, 7%.

Tables are also given, showing lumber production in detail by species and Provinces from 1913 to 1922. Total value of lumber produced in 1922 was $84,554,072, considerably less than that of pulp and paper.

In 1920, the total value of forest products on farms was $72,000,000. This was more than 11% of the total value of all grain crops, over 32% of the value of all forage crops, over 11% *greater* than the value of all other field crops, and 2¾ times the value of all fruit crops.

In 1922, the value of exported wood products was $210,000,000, or nearly one-fourth of the value of total exports. The United States took five-sixths of the value of all wood products exported.

In calculating the probable duration of supplies, a warning is sounded as to the fallacy of merely dividing consumption into volume of resources, because of the approximate nature of present information and losses due to insects, fire and decay. Another source of error is in using exaggerated figures for increment. The best available figures portray a situation that demands vigorous action and unceasing effort on the part of all interests concerned.

From 1918-22, the average annual fire loss was $14,500,000. This figure includes only the stumpage value of timber burned and the actual cost of fire-fighting. For all Canada, the annual loss of merchantable timber from fire is 800,000,000 cubic feet, to which must be added the burning of 1,000,000 acres of young growth. During the last ten years, the average annual loss from the spruce bud worm has been 1,345,000,000 cubic feet. The total annual depletion is figured at 5,000,000,000 cubic feet.

The discussion of resources ends with arguments against devoting all resources to pulp production in any given region, even though such production leads lumber in capital invested and value of output.

Part II deals with the fundamental principles underlying a policy of forest conservation for Canada.

First, it is shown why government must formulate and execute a national forest policy rather than depend upon private initiative.

European experience is cited to show the necessity and desirability of retaining extensive areas under forest cover. It is shown that where Europe has 31.1% of total area in forest, Canada has only 20% of area in forest that is merchantable and accessible, and that per capita consumption in Europe is 38.5 cubic feet as against 285 cubic feet in Canada. It is stated further that conditions are such in Canada and the United States that there need be no conflict between the use of land for agriculture and for forests.

Land classification is advocated immediately on all lands under federal and provincial control and should be encouraged on other lands, because of faulty settlement and improper use of resources that have occurred under past and present policies. After being classified as forest lands, such areas should then be set aside definitely for a forest crop and not be subject to alienation. Further, provision must be made for their proper administration and development.

Comprehensive forest legislation should be based upon the principle of sustained yield. It must also definitely assign the administration of the forest area to some forest authority. After a discussion of the forest legislation of the various Provinces and of the Dominion, this statement is made, "After all, fire protection is not forestry; it is merely a means to an end—to make possible the application of a policy of continuous forest production." (Certainly a much more constructive statement than the one of different tenor which has been spread all too assiduously in this country.)

The present overlapping of authority in the management of timber lands is criticised, and the necessity for a federal law, creating a single agency to be responsible for the entire management of such lands, is emphasized. In this way, the Dominion should lead the way for the Provinces.

The next chapter covers the matter of present dominion and provincial laws regarding forests and points out their disadvantages with suggestions for their improvement. Here is also pointed out the wide discrepancy between the revenue derived from forests and the amount put into their development. At present, actual timber operations on Crown lands are without technical guidance because of unfortunate division of authority.

Forest surveys, the many problems of protection, and the fire organizations of the various Provinces and the Dominion are given full discussion.

Having disposed of all of the more or less preliminary matters, consideration is given to the principles to be followed in the treatment of timbered lands. These may be summarized as follows:

1. Mature timber on agricultural land should be utilized before land is turned over to settlement.

2. Nearly mature timber on agricultural lands, for which there is no present market, should be preserved until they reach maturity.

3. Young stands on agricultural lands that will have no value for many years should be cleared off, if the land is in demand for settlement.

For true forest lands the following should apply:

4. Timber should be cut when it reaches maturity, unless held temporarily for securing better regulation of the cut.

5. Full advantage should be taken of opportunities for securing natural reproduction. Here the immediate need is adequate expenditures for protection.

6. Artificial reproduction should be used only on areas where natural is impossible.

7. Until thinnings can be made to pay, intermediate treatment should consist of good protection against fire and natural enemies and against destructive use and unwise tampering with policy.

8. Utilization should remove from each forest unit an amount each year equal to the annual increment.

9. The operation must be productive of financial profit.

The respects of the Commission are paid to the "diameter limit" as a system that has thoroughly demonstrated its futility. It is further stated that suitable reproduction can be economically secured only by control of the methods of utilization.

The question of slash disposal is considered at some length in very plain language and not at all complimentary to present practice. The conclusions are that disposal has proven practicable when actually enforced; that it must be applied throughout the country; that it must apply to both public and private lands.

In order to secure the benefits of needed improvements in methods of handling and insure a profit to the operator, the public must carry the burden in the form of higher costs of wood products. A plea is presented of an improved method of timber taxation, but no attempt is made at a solution of this problem.

The importance of governmental encouragement of the establishment of city forests is dwelt upon. The present practice of private forestry is shown to be very limited and confined mostly to pulp companies. Such practice also calls for governmental encouragement.

The advantages of planting woodlots and shelterbelts are emphasized together with the conditions encountered in such work and the part government should play.

The necessity for silvicultural research is indicated as well as the importance of the research in forest products.

Some international aspects of forest conservation come in for attention, in which it is shown that Canada and the United States are able to compete in world markets in timber, because they are essentially "price cutters" by reason of their failure to place a proper value upon wood and to make proper expenditures in the care of their resources. By comparing the policies of the United States and Canada with respect to federal forests, Canada is shown to be lagging far behind.

Part II ends with a summary of the recommendations already discussed in the text.

Part III deals solely with the important and, especially at present, interesting subject of pulpwood exports. Three main points of view are considered:

1. Complete embargo on export or such export duty as would reduce amount exported or at least prevent any increase.
2. No embargo or export duty.
3. The national interest.

The arguments of supporters of the first two are then covered in detail.

A memorandum is given in the Appendix, from the Canadian Pulp and Paper Association, favoring an embargo as a help to Canadian industry. This memorandum is lengthy and covers many phases of the situation that are discussed in the body of the report.

Foresters kept out of the argument for the most part, either by failing to appear before the Commission or by confining themselves to discussions of the general situation.

Boards of Trade were divided on the subject, depending upon their degree of contact with utilization.

Lumbermen as a class and farmers cutting pulpwood were opposed to any restrictions on export, as these would narrow their market and

might lead to the imposition of retaliatory tariffs by the United States.

The Appendix contains a memorandum from the American paper companies owning lands in Canada and a brief from the pulpwood exporters, both opposed to embargo or other restrictions.

In summing up the national issue, it is stated that the decision must take into account primarily the condition of supplies, their use and market, together with the effect of restrictions upon each of these items. If an export tax should be adopted, the receipts should be used for better protection and care of the forests.

The Commission rests its case with the statements of facts and leaves the final decision in the matter to the Government without specific recommendation.

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Compiled by Helen E. Stockbridge, Librarian, U. S. Forest Service.

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tection, by C. E. Zerby, p. 165-7; Does the recreational use of the forest justify a large forest investment, by E. A. Ziegler, p. 168-9; The Prehistoric forests of Pennsylvania, by D. White, p. 169-75.

Forstwissenschaftliches centralblatt, Sept. 1, 1924.—Die forstentomologie in Schweden, by K. Escherich, p. 437-47; Auenwirtschaft, by Puster, p. 448-60; Der aufbau der baumschäfte, by W. Hohenadl, p. 460-70.

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Indian forester, Sept. 1924.—How Bombay insures against fodder famine, by T. K. Mirchandani, p. 453-5; The increasing popularity of bakain in the Punjab, by R. M. G., p. 455-6; Strychnine in sandal, by M. G. V. Rao, p. 456-9; Parrotia jacquemontiana for use as hammer handles, by L. N. Seaman, p. 459-62; The unexpected extension of an undesirable type of forest, by L. R. Sabharwal, p. 462-6; The Imperial forestry institute, Oxford, p. 466-9; Forests and rainfall, p. 489-91.

Indian forester, Oct. 1924.—The working of the Hornby charcoal kiln, by E. M. Crothers, p. 501-9; Regeneration fellings in theory and practice, by F. C. F. Robertson, p. 510-16; The economic importance and control of the sal heartwood borer (Hoplocerambyx spinicornis), by C. F. C. Beeson, p. 516-24; The Mysore distillation and iron works, Bhadravati, by S. Kamesam, p. 524-8; The result of clear felling on a seedling crop of Hopea parviflora, by J. M. Sweet, p. 528-31.

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NOTES

HENRY C. WALLACE—LEADER AND FRIEND

BY W. B. GREELEY

The Forest Service has lost a great leader and a sympathetic friend in the death of Secretary Henry C. Wallace. Secretary Wallace came to the Department (March 4, 1921) with a deep interest in national conservation, created by his own study of the land problems of the country and by his intimate contact with Governor Pinchot and other leaders in the earlier phases of the movement.

No Secretary of Agriculture has ever had a more complete grasp of the fundamental things which the National Forests seek to accomplish or of the need for a more complete national forestry policy. Nor has any Secretary had a more sympathetic fellow feeling for his associates in the Government work and for their personal needs and interests. He never lost the hearty, comradely feeling of the man who is bred from the soil and thoroughly understands and shares the viewpoint and aspirations of the plain people. It was always a pleasure for me to take up with him the personal problems and interests of the people in the Forest Service because of his quick and sympathetic understanding of the affairs of everyday life. And there was no more delightful experience than to accompany Secretary Wallace in the field, where he was just as much at home in eating a meal at a ranger station, in talking with a forest guard, or in meeting settlers and stockmen, as he was in mingling with the dignitaries and potentates of the land. Secretary Wallace always had a keen zest for the simple pleasures and everyday interests common to us all, whether it was a fishing expedition, a trip over a National Forest, or a horseshoe pitching contest. And he carried this same broad sympathy and understanding through all of his official duties. Those of us who had the privilege of close association with him will always think of him first as a personal friend.

Secretary Wallace's years as head of the Department of Agriculture were marked by noteworthy accomplishments in national forestry, and in all of them he took an active part. To his persistent and determined efforts was largely due the failure of the attempts to take the National Forests out of the Department of Agriculture and to break up the conservation program in Alaska. He was keenly interested in all of the steps which led to the enactment of the Clarke-McNary forestry law. He not only supported this program in his speeches and reports but appeared personally before the special committee of the United States Senate and gave an extended resume of the whole situation with his own recommendations, upon which the new legislation was very largely drafted. He took a leading part in the work of the National

Forest Reservation Commission and the Federal Power Commission, the latter particularly at a time when his influence was of special value in making the Federal water power policy live and effective.

None of these official duties were discharged by the Secretary perfunctorily. I was often amazed at the way in which, amid the multitudinous and complex demands upon him, with the whole agricultural situation of the country resting upon his shoulders, he would take up some phase of pending work dealing with National Forest administration, or forestry in general, or range management, go to the bottom of it, and put his own personality into its solution. In all of these activities and amid all the conflicting influences and appeals to which he was subjected, he showed remarkable sanity and common sense. He was essentially a builder with a constructive viewpoint on every problem that came before him; but his building was sure and permanent because of his practical grasp of actual conditions and his understanding of the best ways for getting things done.

Nothing has ever inspired me more than the faith which Secretary Wallace so constantly showed and expressed in the aims and ideals of the Forest Service and the confidence which he imposed in the Service as an organization of men and women. Time and again I left his company with a keen sense of the trust which he placed in us no less than the wonderful backing which he was giving to our efforts.

This is the message that, as we respect and cherish his memory, I would like to extend to all of my fellow workers in the Service. Our leader and friend is gone, but his inspiration and his work remain. The best possible commemoration of Secretary Wallace will be for us who carry on to live up to the faith which he had in what we are trying to do and to his trust in our ability and loyalty to accomplish it.

MOIST SHIPMENT OR STORAGE OF SEED

According to Dr. Carl Hartley, Forest Pathologist, the Botanic Gardens at Buitenzorg have developed a very successful method for moist shipment or storage of seed which will not withstand drying. The seed is packed in a mixture of one part charcoal powder and two parts of coconut fiber moistened slightly with a 1 pro 1,000 solution of salicylic acid in water. Sometimes a small amount of spaghnum is also used, but only for very delicate seeds. The seed is shipped in tin containers. Seed in this packing do not decay as they would without the salicylic acid mixture. In many shipments of chestnut seed from Java to the United States, only those in this material have come through alive.

HUMBOLDT SUPERVISORS ESTABLISH SAVE THE REDWOODS FUND

A fund of $25,000 has just been appropriated by the Board of Supervisors of Humboldt County for the purpose of saving the Redwoods. This amount was provided for in the tax levy made by the Board for the ensuing year as the beginning of a Save the Redwoods fund to be utilized as needed in completing the Redwood Park system in Humboldt County. At the meeting of the Board a delegation of Eureka citizens interested in saving the Redwoods appeared, including Mrs. Laura P. Mahan, president of the Woman's Save the Redwoods League of Humboldt County and Mrs. George P. Murray, secretary of the League. They emphasized the great economic value of the Redwoods to Humboldt County as an attraction to tourists and pointed out the tremendous growth in travel along the Redwood Highway that has already taken place.

Humboldt County has already appropriated in the past the sum of $85,000 toward saving Redwood timber in the Humboldt State Redwood Park. This brings the total sum appropriated by them to over $100,000. This action on the part of Humboldt County comes soon after the formal voting by the Board of Supervisors of Del Norte County to set aside an annual fund for the saving of Redwoods along the State Highway. Five thousand was appropriated by them for 1924-25. J. D. Grant of San Francisco, Chairman of the Board of Directors of the Save the Redwoods League, has written to the Humboldt Supervisors and to the Woman's Save the Redwoods League of Humboldt County, congratulating them upon their progressive attitude.

MEETING OF THE WESTERN FORESTRY AND CONSERVATION ASSOCIATION

Vancouver, B. C., December 2 and 3, is the place and date of the meeting this year.

The topics will be those made urgent by recent federal legislation, by the bad fire year, and other developments in fire, forest and tax matters which affect our western states and British Columbia. They will include:

Fire season lessons; fire weather forecast progress; plans for better fire law enforcement; publicity devices; pumps and other equipment; air patrol; restricting campfire building; closing areas to the public; fixing fire fighters' wages; the cut-over land protection problem and who shall meet its costs; slash disposal; forest insects and their control; the new situation created by the McNary Act for federal cooperation, policy covering allotment of federal funds and recognition of private effort; the study of forest taxation provided for by the McNary Act: how it shall proceed on the Pacific Coast; Forestry research by the Government's new experiment station and by the association's new research department: what is being done and should be done.

SOCIETY AFFAIRS

FINAL ANNOUNCEMENT OF THE ANNUAL MEETING

MEETINGS

The Twenty-Fourth Annual Meeting of this Society will be held in Washington, D. C., December 30 and 31, 1924. On the two preceding days the Executive Council will meet at the Forest Service, 930 F St., N. W., to discuss Society business. The Seventy-Ninth Annual Meeting of the American Association for the Advancement of Science occurs in Washington, from December 29, 1924, to January 3, 1925. In all, about 45 Societies are expected to be present, with a representation of about 3,000 members exclusive of those dwelling in Washington.

HOTELS

The headquarters of the A. A. A. S. is the New Willard Hotel, 14th St. and Pennsylvania Ave., N. W. Here tickets will be validated and all kinds of information needed by visitors provided. The headquarters of this Society is the Harrington Hotel, 11th and E Sts., N. W. Take either line of street cars, westbound, from Union Station to 11th St., and walk one block. The Harrington quotes rates as follows:

Running Water			With Bath		
	Double			Double	
Single	Double Bed	Twin Beds	Single	Double Bed	Twin Beds
$3.00	$4.00	$5.00	$3.50-$4.00	$5.00-$6.00	$6.00-$7.00

A limited reservation of rooms has been made at the Harrington, which lapses December 15. Members who desire to lodge there should notify R. V. Reynolds, Secretary, Forest Service, Washington, D. C., without delay, stating the class of quarters desired, and whether willing to take a double room with some other member of the Society.

Those who prefer to make their own arrangements have the choice of many hotels, among which the following have quoted tentative prices:

Hotel	Location	Single Room	Double Room
Arlington	1019 Vermont Ave.	$2.50 and up	$6.00 and up
Burlington	1120 Vermont Ave.	2.50 to $4.00	3.50 to $7.00
Franklin Square	14th & K Sts.	2.50 to 3.50	4.00 to 5.00
Grafton	Conn. Ave., & DeSales St.	1.50 to 2.50	3.00 to 4.00
New Ebbitt	14th & F Sts.	2.50 to 4.00	4.00 to 6.00
New Willard	Penn. Ave., & 14th St.	3.00 and up	5.00 and up
Powhatan	Penn. Ave., & 18th St.	3.00 to $5.00	4.00 to $7.00
Raleigh	Penn. Ave., & 12th St.	3.00 and up	4.00 and up
St. James	Penn. Ave., & 6th St.	2.50 to $4.00	4.00 and up
Shoreham	15th and H Sts.	4.00 and up	6.00 and up

TRANSPORTATION

Reduced railway rates on the certificate plan have been granted to those attending the meeting, from all parts of the United States and from points in Canada east of and including Armstrong, Fort William, and Sault Ste. Marie, Ontario. The return fare under this plan is one-half the regular rate. The reduction does not apply to Pullman fares.

PURCHASING TICKETS TO WASHINGTON

A. For persons residing in the regions of reduced rates (almost all of the United States and Canada, see above). Purchase a first-class, full-fare, one-way, through ticket to Washington, and be sure to secure a certificate on Standard Certificate Form; a receipt is not required.

B. For persons residing outside of the regions of reduced rates. Purchase round-trip ticket to nearest station issuing through tickets to Washington and lying within region of reduced rates. (For western Canadian lines, Chicago). At that station purchase ticket and secure certificate, as directed in preceding paragraph (A).

C. Tickets will be on sale December 22 in the Pacific Coast States and December 24 in other regions.

ENDORSEMENT OF CERTIFICATES BY A. A. A. S. AND VALIDATION BY TRANSPORTATION COMPANIES

Upon arrival at the meeting, register immediately, and on the registration card be sure to fill in the blanks referring to railway tickets. Secure a registration-number card at the Registration desk, in the General Headquarters, New Willard Hotel, Pennsylvania Ave. and 14th St., N. W.

After registering and receiving your registration-number card, leave your railway cerificate at the Validation desk, being sure that your number card is there marked to show that you have deposited a certificate. Retain the number card.

Your certificate will later be endorsed by the agent of the A. A. A. S. and validated by the agent of the transportation companies. A bulletin announcing when validated certificates may be returned to their owners will be posted in a prominent place in the Registration room. Call at the Validation desk for your certificate, presenting your number card. No charge for validation is to be made this year. The last day on which certificates may be validated is December 31.

Unvalidated certificates will not be honored for the purchase of return tickets, and unendorsed certificates can not be validated.

PURCHASING RETURN TICKETS FROM WASHINGTON

The ticket agents at Washington will honor any properly endorsed and validated certificate if presented at least 30 minutes before the train for which it is to be used is due to leave. They will sell you a continuous-passage return ticket for one-half of the regular fare, by the same route as that followed in the trip to Washington. The last date on which return tickets may be purchased is January 7. Travel must begin on that day or earlier.

ANNUAL MEETING

President Mulford has called a special meeting of the Council to consider matters which can not be decided by correspondence. This meeting will occur on December 28 and 29, immediately before the Annual Meeting of the Society, which occupies December 30 and 31, 1924.

Sessions will begin at 9 A. M., December 28, in Room 206, Atlantic Building, 930 F Street, N. W., Washington, D. C. In view of the unusual amount of business, members are requested to be present promptly on the first day.

Members should note that reduced railway rates will be available to them, the reduction being half the regular fare one way. This does not apply to Pullman fares. Tickets will be on sale December 22 on the Pacific Coast and in Arizona. All other regions, December 24. Tickets are good until January 7. When purchasing your ticket to Washington be sure to secure a certificate on the standard certificate form. No receipt is required. Validation by the A. A. A. S. in Washington secures the privilege of buying the return ticket for one-half fare.

Professor Mulford has made his reservation at the Harrington Hotel, a medium priced, conveniently located, and comfortable inn at 11th and E Streets, N. W. A dozen additional rooms have been reserved until December 15 for our members. Tentative prices are: Single rooms, $3 to $3.50; double rooms, $4 to $7. It is advised that Council members reserve rooms at once by writing to me the kind of quarters desired. The hotel prefers to receive the requisitions in a block. The Harrington is headquarters for the National Research Council and the Entomological Society.

R. V. Reynolds, *Secretary.*

SOCIETY OF AMERICAN FORESTERS

Meeting of the Executive Council, December, 1924

Agenda

1. The employment of an Executive Secretary.
   (Stuart, Kirkland, Bryant, Reynolds)
2. Constitution of the Editorial Board.
   (Fisher, Zon)
3. Longer terms of office for all officers.
   (Mulford, Frothingham, Fisher)
4. Decision upon the proposal of Mr. Charles Lathrop Pack.
   (Gift of $1,000 and annual prize) (Mulford, Besley, Stuart)
5. Discussion of Professor Hosmer's statement of policy.
   (Zon, Kirkland, Frothingham, Bryant)
6. The budget for 1925.
   (Besley)

Minor matters which may come up for discussion are:

Revision of the Constitution.

Geographic limits of the Sections.

Printing the membership list.

Choice of candidates to be sent to Europe for research in silviculture and in forest statistics. Under auspices of the Rockefeller Foundation.

Members are asked to accept especial responsibility for the subjects appearing over their names, and to gather such facts as may have a bearing on the decisions to be made.

MEMBERSHIP LIST OF THE SOCIETY OF AMERICAN FORESTERS

NOVEMBER 1, 1924

Fellows

Members	Date Elected
Chapman, Herman Haupt, Yale Forest School, New Haven, Conn.	1905
Graves, Henry Solon, Yale Forest School, New Haven, Conn.	1900
Greeley, William Buckhout, Forest Service, Washington, D. C.	1906
Pinchot, Gifford, Milford, Pa.	1900
Roth, Filibert, Ann Arbor, Mich.	1900
Toumey, James William, 459 Prospect St., New Haven, Conn.	1900
Zon, Raphael, Lake States Forest Experiment Station, University Farm, St. Paul, Minn.	1904

Senior Members

Ahern, George Patrick, 1438 Belmont St., N. W., Washington, D. C.	1914
Akerman, Alfred, Box 79, Petersburg, Va.	1903
Allen, Raymond Walter, Cody, Wyo.	1911
Allison, John Howard, University Farm, St. Paul, Minn.	1909
Amadon, Clarence Henry, 1772 Weeks Ave., New York, N. Y.	1915
Ames, Fred Elijah, Forest Service, Portland, Oreg.	1908
Anderson, Clarence Russell, 310 W. Fairmont Ave., State College, Pa.	1921
Andrews, Prof. H. J.,* Iowa State College, Ames, Iowa	1924
Andrews, William Thomas, Natural Resources (Timber) Bureau of Internal Revenue, Washington, D. C.	1916
Arrivee, David Arthur, Box 664, St. Anthony, Idaho	1921
Ashe, William Willard, Forest Service, Washington, D. C.	1907
Avery, Benjamin Franklin, Spanish River Pulp & Paper Co., Sault Ste. Marie, Ontario, Canada	1921
Ayres, Philip Wheelock, 4 Joy St., Boston, Mass.	1907
Ayres, Robert Williams, Forest Service, San Francisco, Calif.	1923
Backus, Gordon T., Forest Service, Washington, D. C.	1919
Bailey, Harrison Valentine, Franklin, N. J.	1921
Bailey, Irving Widmer, Bussey Bldg., Jamaica Plains, Mass.	1914
Baker, Frederick Stoors, 971 Binford Ave., Ogden, Utah	1916
Baker, Harry Lee, North Carolina Geological & Economic Survey,	

*Acceptance not received.

Senior Members (Contd.) Date Elected

Raleigh, N. C. 1920
Baker, Hugh Potter, 18 E. 41st St., New York, N. Y. 1907
Baker, Willis Miles, Dept. of Conservation and Development, Trenton, N. J. 1920
Bard, George Philip, 800 Penn St., Reading, Pa. 1911
Barrows, William Burnet, Route 3, Magog, P. Q., Canada 1921
Bates, Carlos Glazier, Box 1068, Colorado Springs, Colo. 1910
Bearer, Valentine Mathias, Dept. of Forests and Waters, Ligonier, Pa. 1922
Beede, Victor Augustus, Brown Corp., Quebec, P. Q., Canada 1918
Behre, Charles Edward, 2 Allen St., Amherst, Mass. 1923
Belyea, Harold Cahill, New York State College of Forestry, Syracuse, N. Y. 1920
Benedict, Maurice A., Forest Service, Northfork, Calif. 1923
Bentley, John Jr., Dept. of Forestry, State College of Agriculture, Ithaca, N. Y. 1916
Berry, Swift, Camino, Calif. 1911
Besley, Fred Wilson, 1411 Fidelity Bldg., Baltimore, Md. 1908
Bigelow, Richard L. P.,* Tahoe National Forest, Nevada City, Calif. 1924
Billard, Frederick Howell, Lyon & Billard Co., Meriden, Conn. 1913
Billings, C. Lee,* Edw. Rutledge Timber Co., Coeur d'Alene, Idaho 1924
Birch, Dwight Cullom, 111 North K St., Madera, Calif. 1915
Bishop, Loren Leroy, Forest Service, Warren, Pa. 1921
Bishop, Oliver Frederick, H. A. P. M., Kisaran, Asahan, Sumatra, D. E. I. 1921
Bond, Walter E.,* College Station, Texas 1924
Boyce, John Shaw, Forest Service, Portland, Oreg. 1920
Brewster, Donald Ross, 612 Carew Bldg., Cincinnati, Ohio 1914
Brisco, John Manvers, 380 College Road, Orono, Maine 1914
Brooks, Philip P., 89 State St., Boston, Mass. 1916
Brown, Nelson Courtlandt, New York State College of Forestry, Syracuse, N. Y. 1913
Brundage, Frederick Herbert, Forest Service, Portland, Oreg. 1915
Bruner, E. Murray, Forest Service, Asheville, N. C. 1918
Bryant, Edward Sohier, Harvard Club, Boston, Mass. 1913
Bryant, Ralph Clement, Yale Forest School, New Haven, Conn. 1903

*Acceptance not received.

Senior Members (Contd.)	Date Elected
Buck, C. J., Forest Service, Portland, Oreg.	1923
Butler, Ovid McOuat, American Forestry Assn., 1523 L St., N. W., Washington, D. C.	1911
Calkins, Hugh Gilman, Forest Service, Tucson, Ariz.	1911
Campbell, Robert Henry, 225 Clemow Ave., Ottawa, Canada	1916
Carlisle, George Thomas, Jr., 27 Columbia St., Bangor, Maine	1919
Carter, Edward Edgecombe, Forest Service, Washington, D. C.	1907
Cary, Austin, Forest Service, Washington, D. C.	1905
Cecil, George H., Forest Service, Portland, Oreg.	1917
Chaffee, Reginald Roscoe, Lock Box 41, Endeavor, Pa.	1914
Chandler, Bernard Albert, Timber Section, Bureau of Internal Revenue, Washington, D. C.	1915
Cheney, Edward Gheen, University Farm, St. Paul, Minn.	1908
Chittenden, Alfred Knight, Michigan Agricultural College, East Lansing, Mich.	1903
Churchill, Howard Lincoln, Finch, Pruyn & Co., Glens Falls, N. Y.	1918
Clapp, Earle Hart, Forest Service, Washington, D. C.	1907
Clark, Elias Treat, College of Forestry, University of Washington, Seattle, Wash.	1911
Clark, Ernest Dwight, Route 1, Litchfield, Conn.	1911
Clark, Fay Goodell, School of Forestry, State University, Missoula, Mont.	1916
Clark, Judson F., 285 W. Mountain St., Pasadena, Calif.	1908
Clark, Kenneth McRuer, 50 Grove St., Bangor, Maine	1918
Clark, Robert Eli, Box 218, Monte Vista, Colo.	1921
Clement, George Edward, Elm Hill Farm, Peterborough, N. H.	1903
Cobbs, John Lewis, Jr., Atlantic Coast Line Railroad, Wilmington, N. C.	1918
Coffman, John Daniel, Forest Service, Willows, Calif.	1911
Collingwood, George Harris, Forest Service, Washington, D. C.	1919
Condon, Harry Ruth, Berwyn, Pa.	1921
Cook, Harold Oatman, State Forester, Boston, Mass.	1913
Coolidge, Joseph R., III, 89 State St., Boston, Mass.	1916
Coolidge, Philip Tripp, 31 Central St., Bangor, Maine	1911
Cooper, Albert W., 510 Yeon Bldg., Portland, Oreg.	1923
Cope, Joshua Alban, 207 Cobb St., Ithaca, N. Y.	1921
Cox, William Thomas, 385 Columbus Ave., St. Paul, Minn.	1906

Senior Members (Contd.) Date Elected

Craig, Robert, Jr., Dept. of Forestry, University of Michigan, Ann Arbor, Mich. 1919
Craig, Roland D., 6 Regent St., Ottawa, Canada. 1923
Craighead, Frank Cooper,* Bu. Entomology, Washington, D. C. 1924
Crocker, Douglas, Andrews, 250 State St., Bangor, Maine. 1918
Cromie, George Alexander, 18 Compton St., New Haven, Conn. . . 1915
Crosby, William,* Bureau of Forestry, Manila, P. I. 1924
Crowell, Lincoln, Sandwich, Mass. 1914
Curran, Hugh McCollum, Agricultural Extension Division, Raleigh, N. C. 1905
Dague, William Franklin, 108 S. 5th St., Clearfield, Pa. 1921
Damtoft, Walter Julius, Champion Fibre Co., Canton, N. C. 1918
Dana, Samuel Trask, Northeastern Forest Experiment Station, Amherst, Mass. 1909
Deering, Robert Lane, Forest Service, San Francisco, Calif. . . . 1916
Detwiler, Samuel Bertolet, 119 Beech St., Clarendon, Va. 1907
Dieffenbach, Rudolph, Timber Section, Bureau of Internal Revenue, Washington, D. C. 1916
Drake, George Lincoln, Forest Service, Portland, Oreg. 1918
Drake, Willard Melvin, State Forest Academy, Mont Alto, Pa. . . 1911
Dubuar, James F., State Ranger School, Wanakena, N. Y. 1923
Dunlap, Frederick, 1500 University Ave., Columbia, Mo. 1907
Dunning, Duncan, 253 16th St., Richmond, Calif. 1923
Dunston, Clarence E., Forest Service, San Francisco, Calif. 1911
Duthie, George Argo, Forest Service, Deadwood, S. Dak. 1919
Dwight, Theodore Woolsey, Faculty of Forestry, 11 Queens Park, Toronto, Canada. 1915
Eckbo, Nils Bonnevie, Forest Dept., Pretoria, South Africa. 1916
Edwards, William Grimm, Dept. of Forestry, State College, Pa. 1923
Eggleston, Richard Cunningham, American Tel. & Tel. Co., 195 Broadway, N. Y. 1918
Eldredge, Inman F., Forest Service, Washington, D. C. 1911
Ellis, Leon MacIntosh, Director of Forestry, Wellington, New Zealand 1922
Emerick, Ralph Lynn, 316 Washington Ave., Scranton, Pa. 1921
Evans, Oscar Montgomery, 1770 Sonoma Ave., Berkeley, Calif. 1915
Evans, Robie Mason, Forest Service, Washington, D. C. 1921

ceptance not received.

Senior Members (Contd.) Date Elected

Fahrenbach, John Henry, Timber Section, Bureau of Internal Revenue, Washington, D. C. 1921
Ferguson, John Arden, Dept. of Forestry, State College, Pa. 1911
Ferguson, R. Trevor, Box 1218, Billings, Mont. 1923
Filler, Edmund C.,* 1 Paul Revere Road, Arlington Heights, Mass. 1924
Filley, Walter Owen, Box 1106, New Haven, Conn. 1911
Fischer, Arthur F., Bureau of Forestry, Manila, P. I. 1919
Fisher, Richard Thornton, Athol Road, Petersham, Mass. 1903
Fitzwater, Joseph Albert, 534 Erie St., Sandpoint, Idaho 1920
Flint, Howard Raymond, 716 Beckwith Ave., Missoula, Mont. 1923
Foley, John, 413 Oak Lane, Wayne, Pa. 1902
Forbes, Reginald Dunderdale, 323 Custom House, New Orleans, La. 1918
Foster, Harold Day, Forest Service, Portland, Oreg. 1911
Foster, John Harold, State Forester, Concord, N. H. 1910
Foxworthy, Fred William, Forest Research Office, Kuala Lumpur, Federated Malay States 1911
Freedman, Louis Jacob, Penobscot Development Co., Great Works, Maine 1923
French, Hiram Earl, 1101 Fourth Ave., Durango, Colo. 1916
Fritz, Emanuel, Division of Forestry, University of California, Berkeley, Calif. 1919
Fritz, Jay Macob, Middlebury, Vt. 1922
Fromme, Rudo Lorenzo, Forest Service, Olympia, Wash. 1909
Frothingham, Earl Hazeltine, Box 1518, Asheville, N. C. 1908
Fullaway, Samuel V., Forest Service, Missoula, Mont. 1918
Galarneau, Dennis Camille Amedee, 18 Forest Park Ave., Springfield, Mass. 1923
Garver, Raymond Daniel, Forest Service, Burley, Idaho 1918
Gaskill, Alfred, 15 Linden Lane, Princeton, N. J. 1903
Gaylord, Frederick Alan, Nehasane Park, Nehasane, N. Y. 1911
Gibbons, William H., Forest Service, Portland, Oreg. 1915
Gifford, John Clayton, Cocoanut Grove, Fla. 1902
Girard, James W., Herrick Lumber Co., Burns, Oreg. 1916
Goldsmith, Belknap Chittenden, Forest Service, Sisson, Calif. 1911
Gould, Harry Francis, 89 State St., Boston, Mass. 1919
Granger, Christopher Mabley, Forest Service, Portland, Oreg. 1913

*Acceptance not received.

Senior Members (Contd.) Date Elected

Green, George R., 250 Burrow St., State College, Pa. 1919
Griffin, Alfred Alford, Forest Service, Tacoma, Wash. 1921
Grondal, Bror L., University Station, Seattle, Wash. 1916
Grose, Laurence R., Massachusetts Agriculural College, Amherst, Mass. 1923
Guise, Cedric Hay, Dept. of Forestry, State College of Agriculture, Ithaca, N. Y. 1919
Gutches, George Andrew, 3916 Jenifer St., Washington, D. C. .. 1916
Guthrie, John Dennett, Forest Service, Portland, Oreg. 1907
Haasis, Ferdinand Wead, Box 1518, Asheville, N. C. 1923
Hale, Warren Freeman, State House, Concord, N. H. 1923
Hall, Edwin Howard, Forest Service, Eugene, Oreg. 1921
Hall, Jesse Rexford, Forest Service, Sisson, Calif. 1923
Hall, Rufus Clifford, Timber Section, Bureau of Internal Revenue, Washington, D. C. 1911
Hall, William Logan, Room 1010, 208 S. LaSalle St., Chicago, Ill. 1900
Hamel, Albin Gustav, Federal Bldg., Pueblo, Colo. 1921
Hammatt, Richard Fox, California Redwood Assn., 24 California St., San Francisco, Calif. 1911
Hammer, G. C., Prince Albert, Saskatchewan. 1921
Hanzlik, Edward John, Forest Service, Portland, Oreg. 1916
Harris, Philip Talbot, Forest Service, Okanogan, Wash. 1909
Hastings, Alfred Bryant, Asst. State Forester, Charlottesville, Va. 1916
Hastings, Wilmot Glidden, Timber Section, Bureau of Internal Revenue, Washington, D. C. 1918
Hatton, John Henry, Forest Service, Denver, Colo. 1905
Hawes, Austin Foster, Drawer 1402, Hartford, Conn. 1905
Hawley, Ralph Chipman, Yale Forest School, New Haven, Conn. 1906
Haynes, Frank L.,* 509 Audubon Road, Boston, Mass. 1924
Hazard, James Ovington, Red Cliffs, Uhlerstown, Pa. 1915
Headley, Roy, Forest Service, Washington, D. C. 1915
Heintzleman, B. Frank, Forest Service, Juneau, Alaska. 1915
Heller, Charles Joel, Box 704, Port Arthur, Texas. 1918
Henderson, Hiram L., Route 3, E. Syracuse, N. Y. 1923
Hicock, Henry W.,* 154 Clifford St., New Haven, Conn. 1924
Higgins, Jay, Halsey, Nebr. 1921
Hill, Carey Leroy, 4416 Pleasant Valley Court, Oakland, Calif. . 1907

*Acceptance not received.

Senior Members (Contd.) Date Elected

Hill, William Barlow, 11 Belmont St., Milo, Maine 1923
Hilton, Huber C., Forest Service, Laramie, Wyo 1919
Hirst, Edgar Clarkson, Beecher Falls, Vt 1911
Hoar, Crosby Arthur, 312 Torrey Bldg., Duluth, Minn 1919
Hodgson, Allen Harrison, 804 E. 33rd St., Portland, Oreg 1923
Hoffman, Arthur Frederick Christian, Forest Service, Mancos, Colo. 1916
Hoffman, Bruce E., Forest Service, Portland, Oreg 1915
Hofman, Julius Valentine, Forest Academy, Mont Alto, Pa 1915
Holmes, John Simcox, North Carolina Geological & Economic Survey, Raleigh, N. C 1907
Hopkins, Arthur Sherwood, Conservation Commission, Albany, N. Y. 1914
Hopping, Ralph, Vernon, B. C 1915
Hopson, Raymond Edwin, Dolgeville, N. Y 1922
Hopson, Walter Armstrong, Route 5, Gladwin, Mich 1915
Hornby, Lloyd Gibson, Forest Service, Kalispell, Mont 1920
Hosmer, Ralph Sheldon, Dept. of Forestry, State College of Agriculture, Ithaca, N. Y 1900
Howard, William Gibbs, 68 Brookline Ave., Albany, N. Y 1911
Howe, Clifton Durant, University of Toronto, Toronto, Canada .. 1915
Hoyle, Raymond J., New York State College of Forestry, Syracuse, N. Y 1923
Hubert, Ernest Everett, Missoula, Mont 1921
Humphrey, Clarence John, Forest Products Laboratory, Madison, Wis. 1922
Hutchinson, Wallace Irving, Forest Service, San Francisco, Calif. 1923
Illick, Joseph Simon, P. O. Box 443, New Cumberland, Pa 1915
Jack, John George, East Walpole, Mass 1914
Jackson, Alexander Grant, Forest Service, Portland, Oreg 1913
Jaenicke, Alex Julius, Forest Service, Portland, Oreg 1916
Jardine, James Tertius, Agricultural Experiment Station, Corvallis, Oreg. 1914
Jeffers, Dwight Smithson, Dept. of Forestry, Agricultural College, Ames, Iowa 1916
Johnson, Fred Runk, Forest Service, Denver, Colo 1915
Johnson, Herman M., Forest Service, Medford, Oreg 1915
Johnston, Donald Porter, Okeechobee, Fla 1916
Jones, Richard Chapin, Drawer 329, University, Va 1914

Senior Members (Contd.) Date Elected

Jotter, Ernest Victor, Forest Products Laboratory, Madison, Wis. 1915
Judd, Charles Sheldon, 1828 Vancouver Highway, Honolulu, Hawaii 1910
Kaplan, J. S., Preferred Utilities Co., Fisk Bldg., New York, N. Y. 1921
Keithley, Everard Spencer, P. O. Box 1066, Colorado Springs, Colo. 1923
Keller, John Wyman, Dept. of Forests & Waters, Harrisburg, Pa.. 1921
Kelleter, Paul Delmar, Dept. of Agriculture, Washington, D. C... 1909
Kellogg, Frank Bentley, Crescent City, Oreg........ 1913
Kellogg, Royal Shaw, News-Print Service Bureau, 342 Madison Ave., New York, N. Y........ 1905
Kenety, William Henry, Cloquet Lumber Co., Cloquet, Minn.... 1916
Kent, William H. B., Cazenovia, N. Y........ 1909
Keplinger, Peter, Forest Service, Denver, Colo........ 1921
Kiefer, Francis, 214 Whalen Bldg., Port Arthur, Ontario....... 1911
King, Albert Henry, Speculator, N. Y........ 1916
King, Rex, Forest Service, Safford, Ariz........ 1919
Kinney, J. P., Indian Office, Washington, D. C........ 1913
Kircher, Joseph Casimir, Forest Service, Albuquerque, N. Mex.. 1915
Kirkland, Burt Persons, Dept. of Forestry, University of Washington, Seattle, Wash........ 1909
Kittredge, Joseph Jr., Lake States Forest Experiment Station, University Farm, St. Paul, Minn........ 1918
Klobucher, Frank Joseph, Burns, Oreg........ 1922
Knapp, Myron Donald, U. S. Rubber Plantations, Inc., Penang, Straits Settlements........ 1921
Kneipp, Leon Frederick, Forest Service, Washington, D. C..... 1914
Koch, Elers, Forest Service, Missoula, Mont........ 1905
Koehler, Arthur, Forest Products Laboratory, Madison, Wis.... 1923
Kohout, William G., Jacob Nolde Estate, Reading, Pa........ 1923
Korstian, Clarence Ferdinand, Box 1518, Asheville, N. C....... 1916
Kotok, Edward I., Forest Service, San Francisco, Calif........ 1919
Kraebel, Charles John, Belton, Mont........ 1921
Krauch, Hermann, Forest Service, Albuquerque, N. Mex....... 1915
Krell, Frederick Carl, 613 Gomery-Schwarz Bldg., Philadelphia, Pa. 1921
Krinbill, Howard Ruh, Lanham, Md........ 1918

Senior Members (Contd.)	Date Elected
Krueger, Myron E.,* Northern Lumber Co., Korbel, Calif......	1924
Kummel, Julius Frank, Forest Service, Portland, Oreg.........	1910
Kupfer, Carl Albert, 811 Santa Barbara Road, Berkeley, Calif...	1911
Lafon, John, Jr., M. A. Gringer, 711 Metropolitan Bldg., Vancouver, B. C......................................	1913
Lamb, George Newton, 616 South Michigan Ave., Chicago, Ill...	1916
Lamont, John Donald, 2101 Elmwood Ave., Buffalo, N. Y......	1923
Larsen, Julius Ansgar, Forest Service, Missoula, Mont.........	1918
Lauderburn, Donald Ely, Pejepscot Paper Co., Brunswick, Maine	1923
Leavitt, Clyde, Railway Commission, Ottawa, Canada..........	1908
Leete, Bernard Emerson, 1313 Kinney's Lane, Portsmouth, Ohio	1923
Lentz, Gustav Herman, New York State College of Forestry, Syracuse, N. Y..................................	1923
Leopold, Aldo, Forest Products Laboratory, Madison, Wis......	1913
Levison, Jacob J., Sea Cliff, Long Island, N. Y................	1922
Lindsey, Eugene Lee, Braddock Heights, Alexandria, Va......	1922
Locke, Samuel Barron, Forest Service, Ogden, Utah...........	1918
Lovejoy, Parish Stoors, 1138 Fair Oaks, Ann Arbor, Mich......	1911
Lowdermilk, Walter Clay, School of Agriculture and Forestry, University of Nanking, Nanking, China..................	1922
Ludwig, Walter Dessem, Chambersburg, Pa..................	1921
Lyons, George Washington, Forest Service, Alturas, Calif......	1923
MacDonald, Gilmour Byers, Forestry Dept., State College, Ames, Iowa	1911
MacDuff, Nelson Ferris, Forest Service, Eugene, Oreg.........	1911
MacKaye, Benton, Shirley, Mass...........................	1911
MacMillan, Harvey Reginald, 1022 Metropolitan Bldg., Vancouver, B. C..	1923
McCarthy, E. F., Appalachian Forest Experiment Station, Asheville, N. C..	1916
McHarg, Charles King, Jr., Forest Service, Coeur d'Alene, Idaho	1918
Maddox, Rufus Sherrell, Capitol Annex, Nashville, Tenn.......	1911
Marsh, Raymond Eugene, Forest Service, Albuquerque, N. Mex.	1916
Marsh, Seward Hankins, Forest Service, Harrisonburg, Va.....	1921
Marston, Roy Leon, Skowhegan, Maine......................	1903
Martin, Clyde Sayers, Chief Forest Engineer, Madras, India....	1914
Martin, Dean W., Timber Section, Bureau of Internal Revenue, Washington, D. C..................................	1921

*Acceptance not received.

Senior Members (Contd.) Date Elected

Mason, David Townsend, Northwestern Bank Bldg., Portland, Oreg. 1910
Mason, Frederick Ramsey, Polleys Lumber Co., Rowan, Mont... 1918
Mattoon, Wilbur Reed, Forest Service, Washington, D. C....... 1906
Meek, Charles Robert, 218 S. 13th St., Harrisburg, Pa......... 1921
Meinecke, Emile P., Ferry Bldg., San Francisco, Calif.......... 1914
Merritt, Melvin L., Forest Service, Juneau, Alaska............ 1913
Merritt, Robert Gwathmey, National Lumber Manufacturers Association, Washington, D. C.......................... 1918
Metcalf, Woodbridge, 305 Hilgard Hall, Berkeley, Calif........ 1915
Millar, Willis Norman, 11 Queens Park, Toronto, Canada...... 1911
Miller, Francis Garner, University of Idaho, Moscow, Idaho.... 1904
Miller, Robert Barclay, 223 Natural History Bldg., Urbana, Ill... 1915
Mitchell, John Alfred, Lake States Forest Experiment Station, University Farm, St. Paul, Minn.......................... 1911
Montgomery, William Erdmann, Dept. of Forests and Waters, Harrisburg, Pa.. 1921
Moon, Frederick Franklin, New York State College of Forestry, Syracuse, N. Y... 1911
Moore, Barrington, 925 Park Ave., New York, N. Y........... 1911
Moore, Sidney Luard, Box 1167, Jacksonville, Fla............. 1908
Moore, Walter Morrison, Fairfield Air Intermediate Depot, Fairfield, Ohio.. 1911
Morbeck, George Chester, Forest Products Laboratory, Madison, Wis. 1914
Morrell, Fred W., Forest Service, Missoula, Mont............. 1908
Morrill, Walter Jean, 617 Remington St., Fort Collins, Colo..... 1921
Morse, Chester B., Forest Service, Ogden, Utah.............. 1918
Morse, Howard Bowker, 64 Hawthorne Ave., Bangor, Maine... 1923
Morton, Thomas Roy, Dept. of Forests and Waters, Petersburg, Pa. 1923
Moss, Albert Ernest, Asst. State Forester, Storrs, Conn......... 1921
Mulford, Paul Huntting, 16 Meade St., Wellsboro, Pa......... 1921
Mulford, Walter, Division of Forestry, University of California, Berkeley, Calif...................................... 1904
Munger, Thornton Taft, Forest Service, Portland, Oreg........ 1910
Munns, Edward N., Forest Service, Washington, D. C......... 1919
Munro, Willis, 80 Boylston St., Boston, Mass................. 1918
Murphy, Louis Sutliffe, Forest Service, Washington, D. C...... 1910

Senior Members (Contd.) Date Elected

Nellis, Jesse Charles, Bureau of Foreign and Domestic Commerce, Washington, D. C. 1916
Nelson, John Marburg, Jr., 10 E. Fayette St., Baltimore, Md. 1907
Newins, Harold Stephenson, Penn State College, State College, Pa. 1915
Notestein, Frank Browning, Wooster, Ohio 1914
O'Byrne, Joseph Wilbur, 419 N. E. 4th St., Charlottesville, Va. 1921
Olmsted, Frederick Erskine, Stanford University, Calif. 1900
Olson, David S., Forest Service, Haugan, Mont. 1923
Orr, George Raymond, Forest Service, Quincy, Calif. 1923
Parker, Gordon, 1401 Wood Ave., Colorado Springs, Colo. 1921
Parker, Rutledge, Forest Service, Missoula, Mont. 1914
Paul, Benson H., Forest Products Laboratory, Madison, Wis. 1919
Paxton, Percy Jerauld, Harrisonburg, Va. 1916
Pearson, Gustav Adolph, Forest Service, Flagstaff, Ariz. 1910
Peavy, George Wilcox, Oregon Agricultural College, Corvallis, Oreg. 1906
Peck, Allen Steele, Forest Service, Denver, Colo. 1907
Peirce, Earl Stanley, 300 Kensington Road, Syracuse, N. Y. 1923
Perry, Carl Chamberlain, 276 Church St., Newton, Mass. 1923
Perry, George Sargent, 23 S. Main St., Red Lion, Pa. 1922
Peters, James Girvin, Forest Service, Washington, D. C. 1905
Pettis, Clifford Robert, 365 Quail St., Albany, N. Y. 1908
Pfeiffer, Karl Erwin, 10 Carroll Road, Windsor Hills, Baltimore, Md. 1921
Pflueger, Otto Wilhelm, Los Banos College, Laguna, P. I. 1923
Philips, Ress, P. O. Bldg., Colorado Springs, Colo. 1915
Piché, Gustave C., 64 St. Cyrille St., Quebec, Canada 1915
Pierce, Roy Gifford, Bureau of Plant Industry, Washington, D. C. 1918
Piper, William Bridge, East Tawas, Mich. 1911
Porter, Oliver Moore, 18 E. 41st St., New York, N. Y. 1923
Potter, Albert Franklin, 695 S. Cataline St., Los Angeles, Calif. 1911
Pratt, Merritt Berry, 821 Forum Bldg., Sacramento, Calif. 1908
Prentice, Burr Norman, 255 W. Oak St., West LaFayette, Ind. 1921
Preston, John F., Forest Service, Washington, D. C. 1911
Prichard, Reuben P., New York State College of Forestry, Syracuse, N. Y. 1921
Rachford, Christopher E., Forest Service, Washington, D. C. 1923

Senior Members (Contd.) Date Elected

Ramsdell, Willet Forrest, Forest Service, Baker, Oreg......... 1921
Ramskill, Jerome Hinds, Forest School, University of Montana, Missoula, Mont.. 1911
Randles, Quincy, Forest Service, Albuquerque, N. Mex........ 1916
Recknagel, Arthur Bernard, 706 Stewart Ave., Ithaca, N. Y..... 1908
Record, Samuel James, Yale Forest School, New Haven, Conn.. 1921
Redington, Paul Goodwin, Forest Service, San Francisco, Calif.. 1906
Reed, Franklin Weld, Forest Service, Washington, D. C........ 1921
Reynolds, Robert Van Rensselaer, Forest Service, Washington, D. C.. 1911
Rhoades, Verne, Box 629, Asheville, N. C.................. 1915
Rice, William Benjamin, Forest Service, Weiser, Idaho......... 1918
Richards, Edward C. M., 156 Fifth Ave., New York, N. Y...... 1922
Riley, Smith, U. S. Biological Survey, Washington, D. C........ 1905
Ringland, Arthur Cuming, American Relief Assn., 67 Eaton Square, London, S. W. 1, England..................... 1908
Roak, John Craigie, Tucson, Ariz.......................... 1922
Rogers, David, Nathan, Forest Service, Quincy, Calif.......... 1911
Rogers, J. S., Center Sandwich, N. H....................... 1916
Rothery, Julian Eastman, 527 Fifth Ave., New York, N. Y...... 1911
Rupp, Alfred Eugene, 210 S. Market St., Mechanicsburg, Pa.... 1921
Russell, Harold Louis, Forest Service, Harrisonburg, Va....... 1921
St. Clair, Robert C., care Chief Forester, Victoria, B. C........ 1918
Sampson, Arthur William, 305 Hilgard Hall, University of California, Berkeley, Calif.................................. 1923
Sanford, Earl Clifford, Forest Service, Montpelier, Idaho....... 1918
Sanford, Frank Hobart, 437 Abbot Road, East Lansing, Mich.. 1915
Schaaf, Marcus, State Forester, Grayling, Mich............... 1919
Schanche, H. G.,* Chief Forester, Abitibi Power & Paper Co., Ltd., Iroquois Falls, Ontario............................ 1924
Scherer, Norman W., Ohio State University, 2097 Summit St., Columbus, Ohio...................................... 1919
Schmitt, Karl, Timber Section, Bureau of Internal Revenue, Washington, D. C................................... 1919
Schmitz, Henry, School of Forestry, University of Idaho, Moscow, Idaho 1923
Schwab, Walter Groff, La Plata, Md........................ 1921
Schwarz, George Frederick, Dennis, Mass................... 1902
Sears, H. M., Forest Service, Lynchburg, Va................. 1923

*Acceptance not received.

Senior Members (Contd.) Date Elected

Sewall, James Wingate, Oldtown, Maine.................... 1915
Sheals, Ralph A.,* 129 State House, Providence, R. I.......... 1924
Shepard, Edwin Clytus, Forest Service, Boise, Idaho........... 1916
Shepard, Harold Blaisdell, 832 Park Square Bldg., Boston, Mass. 1922
Shepard, Ward, Forest Service, Washington, D. C............. 1919
Sherman, Edward A., Forest Service, Washington, D. C....... 1915
Shields, Robert Wilson, Forest Service, Franklin, N. C......... 1918
Shinn, Charles Howard, Northfork, Calif.................... 1907
Show, Stuart Bevier, Forest Service, San Francisco, Calif....... 1919
Siecke, Eric Otto, A. & M. College, College Station, Texas..... 1908
Silcox, Ferdinand Augustus, 131 W. 70th St., New York, N. Y. 1907
Silvius, Arthur Charles, 210 S. Center St., Pottsville, Pa........ 1922
Simmons, James Raymond, 93 State St., Albany, N. Y........ 1921
Simpson, Charles Donald, Forest Service, Missoula, Mont....... 1918
Smith, Charles Stowell, 857 San Diego Road, Berkeley, Calif.... 1910
Smith, Clinton Gold, Forest Service, Washington, D. C......... 1909
Smith, Herbert A., Forest Service, Washington, D. C.......... 1918
Smith, Stanton Gould, Box 94, Auburn Maine................. 1909
Somers, John B., Forest Service, Dillon, Mont................ 1916
Sonderegger, Victor Hugo, Supt. of Forestry, New Orleans, La. 1922
Sparhawk, William Norwood, Forest Service, Washington, D. C. 1916
Spaulding, Thomas Claude, University of Montana, Missoula, Mont. 1914
Spencer, John W., Forest Service, Sheridan, Wyo............. 1921
Spring, Samuel Newton, Dept. of Forestry, State College of Agriculture, Ithaca, N. Y.................................... 1904
Stabler, Herbert Osburn, Forest Service, Washington, D. C.... 1908
Staebner, Ralph C., Meadow River Lumber Co., Rainelle, W. Va. 1921
Stahl, Carl J., Forest Service, Denver, Colo.................. 1916
Staley, Lewis Emery, 426 Park Ave., Camp Hill, Pa............ 1921
Stephen, John Wallace, New York State College of Forestry, Syracuse, N. Y.. 1911
Sterling, Ernest Albert, Borden Bldg., 350 Madison Ave., New York, N. Y.. 1903
Sterrett, William Dent, 35th and Rodman Sts., N. W., Washington, D. C... 1906
Stevens, Carl Mantle, Northwestern National Bank Bldg., Portland, Oreg.. 1916

*Acceptance not received.

Senior Members (Contd.) Date Elected

Stewart, Sidney Smith, 349 34th St., Ogden, Utah............. 1921
Stockdale, Lewis C., Forest Service, Missoula, Mont........... 1923
Stokes, Joseph Warrington, 901 N. 18th St., Boise, Idaho....... 1916
Stuart, Robert Young, Dept. of Forests and Waters, Harrisburg, Pa. 1911
Sudworth, George Bishop, Forest Service, Washington, D. C.... 1900
Swan, Orrington Thomas, Box 669, Oshkosh, Wis............. 1911
Sweet, Carroll, V., Forest Products Laboratory, Madison, Wis.. 1921
Sylvester, Albert Hale, Federal Bldg., Wenatchee, Wash....... 1916
Talbot, Murrell Williams, Bureau of Plant Industry, Washington, D. C. 1919
Taylor, John Baker, Forest Service, Butte, Mont.............. 1923
Terry, Elwood Idell, 327 E. 20th St., Baltimore, Md........... 1911
Thompson, Myron Wood, 471 New Federal Bldg., Denver, Colo. 1916
Thompson, Sidney Hammond, Timber Section, Bureau of Internal Revenue, Washington, D. C......................... 1921
Tiemann, Harry Donald, Forest Products Laboratory, Madison, Wis. 1905
Tierney, Dillon Parnell, Timber Section, Bureau of Internal Revenue, Washington, D. C.............................. 1911
Tillotston, Claude Raymond, Forest Service, Washington, D. C.. 1911
Tinker, Earl W., 3922 W. 29th Ave., Denver, Colo............ 1921
Tompkins, Harry James, Box 519, Pasadena, Calif............. 1902
Treen, Lewis A., 553 Stuart Bldg., Seattle, Wash............. 1919
Truax, Thomas Roy, 1902 Madison St., Madison, Wis.......... 1916
Upson, Arthur T., 412 Transportation Bldg., Washington, D. C. 1914
Van Boskirk, Serrin S., Forest Service, Ephriam, Utah......... 1919
Viles, Blaine Spooner, Augusta Trust Co. Bldg., Augusta, Maine 1908
Von Bayer, William Hector, 1626 Swan St., Washington, D. C.. 1908
Waha, Alpheus Oliver, Forest Service, Portland, Oreg......... 1908
Wales, Henry Basil, Forest Service, Prescott, Ariz............. 1919
Warner, Joseph DeWitt, 414 Northwestern National Bank Bldg., Portland, Oreg.. 1908
Warren, Murrell Charles, Arcata, Calif...................... 1922
Watson, Russell, 305 Chamber of Commerce Bldg., Milwaukee, Wis. 1921
Watts, Lyle Ford, Forest Service, McCall, Idaho.............. 1921
Weidman, Robert H., Forest Service, Missoula, Mont.......... 1921
Weigle, William Grant, 4722 16th Ave., N. E., Seattle, Wash.... 1906

Senior Members (Contd.)	Date Elected
Weiss, Howard Frederick, 2021 Monroe St., Madison, Wis.	1907
Wentling, John Philip, University of Minnesota, University Farm, St. Paul, Minn.	1908
Westveld, Marinus, Northeastern Forest Experiment Station, Amherst, Mass.	1919
White, David George, Brunson Bldg., Columbus, Ohio	1919
White, Edgar Fowler, Forest Products Laboratory, Madison, Wis.	1914
White, James Herbert, Faculty of Forestry, University of Toronto, Toronto, Canada	1915
White, Wilfored W., Forest Service, Missoula, Mont.	1921
Whitford, Harry Nichols, Dept. of Commerce, Washington, D. C.	1911
Whitham, James Campbell, Forest Service, Newport, Wash.	1921
Wieslander, Albert Everett, Forest Service, Susanville, Calif.	1923
Wilber, Charles Parker, State House, Trenton, N. J.	1911
Willey, Wilford Bennett, P. O. Box 1746, Great Falls, Mont.	1920
Williams, Asa Starkweather, 330 Seymour St., Vancouver, B. C.	1909
Williams, Kinne F., Conservation Commission, Albany, N. Y.	1923
Wilson, Ellwood, Laurentide Co., Ltd., Grand Mere, P. Q. Canada	1915
Winkenwerder, Hugo, College of Forestry, University of Washington, Seattle, Wash.	1911
Winslow, Carlile Patterson, Forest Products Laboratory, Madison, Wis.	1923
Winter, Raymond Burrows, Dept. of Forests and Waters, Mifflinburg, Pa.	1921
Wirt, George Herman, Dept. of Forests and Waters, Harrisburg, Pa.	1910
Wohlenburg, Ernest T. F., Timber Section, Bureau of Internal Revenue, Washington, D. C.	1919
Wolfe, Stanley Lloyd, Timber Section, Bureau of Internal Revenue, Washington, D. C.	1918
Wolff, Meyer Henry, Forest Service, Missoula, Mont.	1915
Woodbury, Truman Doane, Forest Service, San Francisco, Calif.	1908
Woods, John B., Long-Bell Lumber Co., Kansas City, Mo.	1921
Woodward, Karl Wilson, University of New Hampshire, Durham, N. H.	1906
Woolsey, Theodore Salisbury, Jr., 242 Prospect St., New Haven, Conn.	1905

Senior Members (Contd.) Date Elected

Work, Herman, W. Virginia Pulp and Paper Co., Tyrone, Pa... 1916
Worthley, Irving Tupper, Route 3, Phoenixville, Pa............ 1911
Wulff, John Victor, Forest Service, Sonora, Calif............ 1923
Wyman, Lenthall, Box 337, Starke, Fla...................... 1920
Yarnall, Ira Thornton, Box D., Gorham, N. H................ 1916
Young, Liegh Jarvis, 911 Forest St., Ann Arbor, Mich......... 1916
Ziegler, Edwin Allen, State Forest Academy, Mont Alto, Pa.... 1907

Members

Abbott, Arthur Hale, Box 1163, Helena, Mont................ 1921
Adams, Adrian Carl, Forest Service, Grangeville, Idaho......... 1920
Adams, John Amos, Forest Service, Flagstaff, Ariz............ 1921
Ade, Harry George, Forest Service, Missoula, Mont........... 1921
Adolph, Raymond D., Forester, Palisades Interstate Park, Newburgh, N. Y.. 1924
Agee, Fred B., Forest Service, Saguache, Colo................ 1921
Alderman, Ovid Adile, Ohio Agricultural Experiment Station, Wooster, Ohio.. 1923
Alvarez, Ramon J., Bureau of Forestry, Manila, P. I........... 1924
Amadon, Arthur Franklin, Conservation Commission, Albany, N. Y. 1921
Ames, John Stanley, North Easton, Mass..................... 1923
Anderson, Irvin Victor, Forest Service, Thompson Falls, Mont.. 1923
Anderson, Olof C.,* 129 State House, Providence, R. I......... 1924
Anderson, Parker Oscar, 1614 Jefferson Ave., St. Paul, Minn.... 1921
Anderson, S. Duval, Forest Service, Deadwood, S. Dak......... 1923
Andrews, Cass, Pacific Lumber Co., 332 S. Michigan Ave., Chicago, Ill. 1923
Arthur, O. Fred., Forest Service, Alamogordo, N. Mex........ 1921
August, William Anthony, 618 Main St., Stroudsburg, Pa...... 1923
Averill, Robert Wallace, Stillwater, Maine.................. 1923
Averill, Walter B., 36 Starrett Ave., Athol, Mass............. 1923
Ayers, Benjamin Kimball, 35 Auburn St., Concord, N. H....... 1921
Baer, Charles Eugene, Hotel Warner, Emporium, Pa.......... 1923
Baldwin, William Lothrop, Southern Lumber Co., Warren, Ark. 1920
Banzhaf, George Leo, 876 Hackett Ave., Milwaukee, Wis...... 1923
Barker, William Luther, Jr., Forest Service, Ely, Minn........ 1921
Barnes, John S., 305 Hilgard Hall, University of California, Berkeley, Calif. 1923

*Acceptance not received.

Members (Contd.) Date Elected

Barnum, Millard M., Forest Service, Nevada City, Calif........ 1923
Barraclough, Kenneth E., 105 Water St., Exeter, N. H.......... 1924
Barrett, Louis A., Forest Service, San Francisco, Calif........ 1920
Basnett, Douglas,* 3 E. 85th St., New York, N. Y............. 1924
Baum, Arthur Mason, 811 S. 4th St., Missoula, Mont.......... 1920
Beatty, Dwight Luther, Forest Service, Missoula, Mont......... 1920
Berry, John Richard, Forest Service, San Francisco, Calif...... 1923
Bietsch, Tom Oscar, 133 North East St., Carlisle, Pa.......... 1923
Billingslea, James Howell, Forest Service, Olympia, Wash...... 1923
Bird, Royal G., Forestport, N. Y.......................... 1923
Bishop, Arthur F., Clipper Mills, Calif..................... 1923
Black, Wallace Dunn, Flora Dale, Pa....................... 1923
Blair, Earl Murray, care U. S. R. P. Inc., Boenoet Kisaran, Sumatra, D. E. I.. 1922
Bode, Irwin T.,* Dept. of Forestry, Iowa State College, Ames, Iowa 1924
Bodine, Alfred Wells, Union National Bank Bldg., Huntingdon, Pa. 1924
Bonney, Parker Samuel, District Forester, Prince Rupert, B. C.. 1921
Boomer, Stephen Henry, Box 303, Conway, N. H............. 1923
Boyce, Charles Ward, Forest Service, Washington, D. C....... 1921
Boyce, Walter Henry, 353 Moshola Parkway N., New York, N. Y. 1923
Bradner, Melvin Ira, Forest Service, Missoula, Mont.......... 1923
Brandborg, Guy Mathew, Forest Service, Helena, Mont........ 1923
Brayton, S. C., Consolidated Water Power & Paper Co., Wisconsin Rapids, Wis.................................... 1922
Bremicker, Joel Herman, 1007 Syndicate Trust Bldg., St. Louis, Mo. 1921
Bright, George Adams, Forest Service, Portland, Oreg......... 1921
Brinckerhoff, H. E., Vitale & Rothery, 101 Park Ave., New York, N. Y. 1924
Broadbent, Sam Robert, Forest Service, Helena, Mont......... 1923
Brockway, Earle M., 106 Main St., Brockton, Mass........... 1924
Brooks, Alonzo Beecher, Buckhannon, W. Va................ 1921
Brooks, James Forrest, Forest Service, St. Maries, Idaho....... 1921
Brouse, Edgar Frederick, Boalsburg, Pa..................... 1923
Brown, Harry Philip, State College of Forestry, Syracuse, N. Y. 1921

*Acceptance not received.

Members (Contd.) Date Elected

Brown, Lee Peter, Forest Service, Medford, Oreg. 1923
Brown, Randolph M., Forest Service, Washington, D. C. 1923
Brundage, Marsden Robert, Forest Service, Sonora, Calif. 1923
Brush, Warren David, Forest Service, Washington, D. C. 1919
Bryner, Harold Emory, 2651 N. 5th St., Harrisburg, Pa. 1923
Burleigh, Thomas Dearborn, 190 Cloverhurst St., Athens, Ga. . . 1923
Burnes, John D., 1955 St. Anthony Ave., St. Paul, Minn. 1921
Burnett, Orville P., Forest Service, Alturas, Calif. 1923
Burns, Mark Libby, Cass Lake, Minn. 1923
Burrage, Clarence Hill, Kentucky Agricultural Experiment Station, Quicksand, Ky. 1923
Buttrick, Philip Laurance, 205 Prospect St., New Haven, Conn. . 1921
Byers, William Lester, McConnellsburg, Pa. 1923
Campbell, Royston Elliot, 773 Pettygrove St., Portland, Oreg. . . 1923
Canterbury, Nathan D., 113 Maple St., West Roxbury, Mass. . . 1924
Carroll, Francis Thomas, Forest Service, Newport, Wash. 1921
Cary, Norman Leroy, 510 Yeon Bldg., Portland, Oreg. 1921
Chapline, William Ridgley, Forest Service, Washington, D. C. . . 1919
Chapman, Chauncey Wallace Lord, University of Maine, Orono, Maine 1923
Christie, Herbert Reed,* University of Columbia, Vancouver, B. C. 1924
Clack, John Henry, Forest Service, Missoula, Mont. 1923
Claridge, Bertram E., Hammermill Paper Co., Mantane, Quebec 1921
Clark, Burr W., Forest Service, Bozeman, Mont. 1921
Clark, Donald Hathaway, 5520 White Bldg., Seattle, Wash. 1921
Clark, E. V., 1102 E. Alabama St., Houston, Texas. 1921
Cleator, Frederick William, 364 E. 55th St., N., Portland, Oreg. 1921
Clement, Philip Poindexter, 27 Columbia St., Bangor, Maine. . . . 1922
Clepper, Henry Edward, 316 Washington Ave., Scranton, Pa. . . . 1923
Cline, Albert Collins, Harvard Forest, Petersham, Mass. 1923
Coan, Hamilton Morel, 76 Elm St., Montclair, N. J. 1921
Cochran, Harry Dean, 57 S. Clarkson St., Denver, Colo. 1923
Colgan, Richard Andrew, Diamond Match Co., Chico, Calif. 1921
Conklin, Joel Shepard, Clover Valley Lumber Co., Loyalton, Calif. 1923
Conner, James F., Forest Service, Custer, S. Dak. 1921
Cook, Irwin Wycliffe, 429 S. 5th St. E., Missoula, Mont. 1921
Cope, H. Norton, Forest Service, Williams, Ariz. 1921

*Acceptance not received.

Members (Contd.) Date Elected

Coulson, Edward Hutchinson, Forest Service, Coeur d'Alene, Idaho 1920
Coville, Perkins,* Iowa State College, Ames, Iowa 1924
Coyle, Leonidas, Dept. of Conservation and Development, Trenton, N. J. 1923
Crawshaw, Thomas Hill, Finch, Pruyn & Co., Glens Falls, N. Y. 1923
Cronk, Corydon P., 52 Sommer Ave., Maplewood, N. J. 1919
Cunningham, Russell N., Forest Service, Missoula, Mont. 1921
Cuno, John B., Forest Service, Washington, D. C. 1921
Curtin, George D., Curtin, W. Va. 1923
DaCanay, Placido, Bureau of Forestry, Manila, P. I. 1924
Dahlgren, Calvin Anok, Forest Service, Ely, Minn. 1920
Dain, Bryant Depew, Forest Products Laboratory, Madison, Wis. 1923
Damon, Kennan, Concord Junction, Mass. 1924
Davis, Edward Manning, Forest Products Laboratory, Madison, Wis. 1923
Davis, Harry Stephen, Franconia, N. H. 1921
Davis, Samuel E., Jr., Dept. of Forestry, New York State College of Agriculture, Ithaca, N. Y. 1924
Davis, Virgil B., Fort Bragg, Calif. 1923
Dean, Forest William, Madison Hill, Wooster, Ohio 1923
DeCamp, Lee Roy, Truckee, Calif. 1921
DeJarnette, George Monroe, Forest Service, Sandpoint, Idaho .. 1923
Delevan, Carlyn C., Wanakena, N. Y. 1920
DeLong, Charles Aubrey, Clark's Corner, Conn. 1923
Demeritt, Dwight Burgess, University of Maine, Orono, Maine .. 1924
Deutsch, Henry C., 404 Fargo St., Portland, Oreg. 1923
Dewald, Floyd Irwin, Forest Service, Polebridge, Mont. 1923
Dohanian, Senekerim Mardiros, 42 Cedar St., West Somerville, Mass. 1924
Doherty, William Thomas, Forest Service, Santa Fe, N. Mex. 1921
Donery, Joseph Anthony, Forest Service, Denver, Colo. 1923
Door, George Stanley, Dept. of Agriculture, State House, Boston, Mass. 1924
Dorward, David Lawson, Hollingsworth & Whitney, Waterville, Maine 1921
Douglas, Lynn H., 463 P. O. Bldg., Denver, Colo. 1921

*Acceptance not received.

Members (Contd.) Date Elected

Douthitt, Fred D., Forest Service, Yreka, Calif................ 1919
Downs, Robert Campbell, Larabee, Calif...................... 1923
Dreitzler, Ralph Francis, Box 61, Creosote, Wash............. 1923
Drolet, George, Box 28, Tuscaloosa, Ala...................... 1922
Dudley, Ernest Griswold, Route A, Box 180, Exeter, Calif...... 1919
Durbin, William G., Susanville, Calif......................... 1920
Durland, William Davies, University of Porto Rico, Mayaguez, P. R. 1923
Eger, Bernard Albert, Box 266, Lakewood, N. J............... 1923
Ehrhart, Edmund Oscar, 708 Penn St., Johnsonburg, Pa........ 1923
Elliott, Joseph Clinton, 6427 Hillegas Ave., Oakland, Calif..... 1923
Elofson, Harry William, Forest Service, Dillon, Mont.......... 1923
Emigh, Perry, Stout Lumber Co., North Bend, Oreg.......... 1922
Endersbee, William James, 5 May St., Rochester, N. H........ 1923
Ericksen, Leyden N., Forest Products Laboratory, Madison, Wis. 1923
Ericson, Oliver F., Forest Service, Olympia, Wash............. 1921
Evans, Charles F., Forest Service, Ogden, Utah............... 1921
Everitt, John Samuel, Forest Service, Quincy, Calif............ 1922
Faulkner, George Annand, Forest Dept., Augusta, Maine....... 1923
Favre, Clarence Eugene, Kemmerer, Wyo.................... 1921
Fickes, Clyde Phillips, Sheridan, Mont....................... 1923
Fletcher, Elmer Douglas, care R. G. Pond, Parkdale, Oreg...... 1921
Flintham, Stuart John, 904 Hall of Records, Los Angeles, Calif. 1921
Forsaith, Carl Cheswell, New York State College of Forestry, Syracuse, N. Y... 1923
Forsling, Clarence L., Forest Service, Ephriam, Utah........... 1921
Friend, Francis Howard, 342 Water St., Skowhegan, Maine..... 1923
Frontz, Leroy, Clearfield Bituminous Coal Corp., Indiana, Pa.. 1923
Frost, Walter O.,* Blister Rust Control in Maine, Augusta, Maine 1924
Furst, Frederick William, Forest Service, Baker, Oreg......... 1923
Gamash, Albert Williams, Parent, P. Q., Canada.............. 1921
Gerhardy, Carl Otto, Union Lumber Co., Fort Bragg, Calif..... 1923
Gery, Raymond Earl, Forest Service, Ogden, Utah............. 1921
Gill, Thomas Harvey, Forest Service, Washington, D. C........ 1923
Gillis, James R., Bureau of Forestry, Manila, P. I............. 1924
Gisborne, Harry Thomas, Forest Service, Missoula, Mont....... 1921
Goodwin, James Lippincot, 71 Woodland St., Hartford, Conn... 1921
Gordon, George Benedict, 61 Sunnyside Ave., Pleasantville, N. Y. 1923

*Acceptance not received.

Members (Contd.) Date Elected

Gowen, George M., Forest Service, Placerville, Calif. 1922
Graham, Samuel Alexander, University Farm, St. Paul, Minn. . . 1921
Green, Charles Burdett, Forest Service, San Francisco, Calif. . . . 1923
Hadley, Evan Worth, Box 417, Bogalusa, La. 1921
Haines, Paul Byram, Stokes State Forest, Branchville, N. J. 1923
Haines, Roscoe, Anaconda Copper Mining Co., Butte, Mont. . . . 1920
Hall, Ansel Franklin, Yosemite, Calif. 1921
Hall, Sherwood J., Jas. D. Lacey Co., 350 Madison Ave., New York, N. Y. 1924
Hanly, Donald H.,* Thomaston, Maine. 1924
Hanly, Edward Kavanaugh, P. O. Box 106, Thomaston, Maine. . 1922
Hansen, Thorwald Schantz, Cloquet, Minn. 1921
Harbeson, Thomas Clyde, Milroy, Pa. 1923
Harley, William Pollock, Indian Service, Dulce, N. Mex. 1923
Harrington, Cornelius Louis, Conservation Commission, Madison, Wis. 1922
Hartwell, Edward Walker, P. O. Box 929, Miles City, Mont. . . . 1921
Hash, C. J., Box 557, Kalispell, Mont. 1923
Hawkins, Guy Carleton, New England Box Co., Winchester, N. H. 1923
Hawley, Lee Fred, 803 State St., Madison, Wis. 1921
Hayes, William Danforth, 33 Jefferson St., Bangor, Maine. 1922
Heald, Philip Clark, Wilton, N. H. 1922
Hendron, Harold Hayden, Livingston, Mont. 1923
Herzig, Alfred Sebastian, Hammond Lumber Co., Samoa, Calif. 1923
Hick, Robert Milton, Rocky Hill, Conn. 1923
Hill, Robert R., Forest Service, San Francisco, Calif. 1923
Hill, W. F., Forest Service, Pensacola, Fla. 1921
Hill, William Norbert, Western Electric Co., 463 West St., New York, N. Y. 1924
Hine, Willard R., Forest Service, 323 Custom House, New Orleans, La. 1923
Hogeland, Charles Clarence, Driftwood, Pa. 1921
Hogue, Roy Lincoln, 729 Fairview Ave., Jackson, Miss. 1923
Hope, Luther S., Box 925, Nelson, B. C. 1921
Hopkins, Howard, Forest Service, Glenwood Springs, Colo. 1924
Horning, Walter Harold, State Forest Academy, Mont Alto, Pa. . 1923
Houpt, Richard Ritchey, Clearfield, Pa. 1923

*Acceptance not received.

Members (Contd.) Date Elected

Hult, Gustaf Wilhelm, 981 Southern Pacific Bldg., San Francisco, Calif. 1921
Hunt, George McMonies, Forest Products Laboratory, Madison, Wis. 1921
Hunter, Gerald M., Forest Service, Glenwood Springs, Colo.... 1921
Hutton, Andrew, Forest Service, Cody, Wyo.......... 1921
Hyde, Solon John., 20 Saviolette Ave., Three Rivers, P. Q., Canada 1923
Isaac, Leo Anthony, Wind River Experiment Station, Stabler, Wash. 1923
Ivory, Edward P., Forest Products Laboratory, Madison, Wis.. 1923
Janouch, Karl, Lawrence, Forest Service, Nenzel, Nebr.......... 1923
Jefferson, Frank Joseph, Forest Service, Kooskia, Idaho.......... 1921
Jensen, Christian, Oklahoma, A. & M. College, Stillwater, Okla.. 1921
Johnson, Eric Alfred, Forest Service, Salida, Colo.......... 1923
Johnston, Herbert William, University of Montana, Missoula, Mont. 1921
Jones, Bryant Emerson, Forestry Dept., Augusta, Maine.......... 1923
Jones, Ernest Fuller, 401 Center St., Bangor, Maine.......... 1921
Jones, George Willard, Forest Service, Haugan, Mont.......... 1921
Jones, John Davis, Forest Service, Albuquerque, N. Mex.......... 1921
Jones, Thomas Johnson, Forest Service, Bishop, Calif.......... 1922
Jotter, Walter Ehresmann, Forest Service, Porterville, Calif.......... 1921
Kelley, Evan W., Forest Service, Washington, D. C.......... 1920
Kelly, F. A., Forest Service, Ely, Minn.......... 1923
Kempff, Gerhard Santoshem, Priest River Experiment Station, Priest River, Idaho.......... 1923
Kephart, George Stebins, 149 Cedar St., Bangor, Maine.......... 1922
Kerr, John, Forest Service, Albuquerque, N. Mex.......... 1921
Kimball, George Whitehead, Forest Service, Williams, Ariz.......... 1921
Kramer, Geo. P., West Penn Power Co., 14 Wood St., Pittsburgh, Pa. 1924
Kreutzer, William Richard, Box 567, Fort Collins, Colo.......... 1923
Knouf, Clyde Ellsworth, Forest Service, Missoula, Mont.......... 1920
Kroodsma, Raymond Frederick, 818 Summerville Ave., Lansing, Mich. 1923
Krueger, Theodore, Forest Service, Gunnison, Colo.......... 1921
Kurtz, Samuel Longacre, W. Church St., Ligonier, Pa.......... 1923
Kutz, Donald B., 304 S. 5th St., Reading, Pa.......... 1923

Members (Contd.) Date Elected

Lachmund, Harry Gray, Forest Service, San Francisco, Calif... 1923
LaMonte, Archibald Douglas, Watchung Road, Bound Brook, N. J. 1923
Landmesser, Frank R., Inspectors Lumber Co., West Chazy, N. Y. 1924
Lang, Duncan McRae, Forest Service, Albuquerque, N. Mex.... 1921
Langdell, Russell Stearns, 19 Belmont St., Lowell, Mass........ 1922
Leach, Walter, Mount Union, Pa.......... 1923
Lee, Chester A., Box 567, Fort Collins, Colo.......... 1923
Lee, Isaac Laurance, State College of Forestry, Syracuse, N. Y. 1921
Lee J. G., Louisiana State University, Baton Rouge, La........ 1921
Lefkof, Emil Alfred, Pennsylvania Railroad Co., 422 N. Main St., Wilkes-Barre, Pa.......... 1924
Leighou, John V., Box 115, Hot Sulphur Springs, Colo......... 1921
Lessel, Leonard Rex, Forest Service, Holbrook, Ariz.......... 1922
Lindenmuth, Luther Moll, Room 1618, 195 Broadway, New York, N. Y. 1923
Lindsay, William, Dept. of Conservation and Development, Trenton, N. J.......... 1923
Lockwood, Milton Keith, Timber Section, Bureau of Internal Revenue, Washington, D. C.......... 1923
Lodewick, John Elton, New York State College of Forestry, Syracuse, N. Y.......... 1923
Lodge, Llewellyn Van Alst, American Tel. & Tel. Co., 195 Broadway, New York, N. Y.......... 1921
Loetzer, Louis C., 434 W. Queen St., Chambersburg, Pa........ 1923
Long, William Henry, 244 Korber Bldg., Albuquerque, N. Mex. 1922
Lovely, Harry Richard, 138 Main Ave., Gardiner, Maine....... 1923
Loveridge, Earl W., Forest Service, Albuquerque, N. Mex...... 1919
Lowell, John Wesley, 617 N. 5th St., Hamilton, Mont.......... 1923
Lufburrow, Burley M., Moulton, Ala.......... 1924
Lumsden, Howard Mason, Forestry Dept., University of Michigan, Ann Arbor, Mich.......... 1923
Lyman, Robert R.,* Gray Chemical Co., Coudersport, Pa....... 1924
McCallister, Jack Carroll, Forest Service, Hot Sulphur Springs, Colo. 1923
McKee, Elijah Reese, Forest Service, Valparaiso, Fla.......... 1921
McKenzie, Claude Willard, 40 W. Pennington St., Tucson, Ariz. 1922
McLaren, John, Forest Service, Denver, Colo.......... 1923

*Acceptance not received.

Members (Contd.) Date Elected

McLaughlin, Robert Palmer, 629 Plymouth St., Missoula, Mont. 1921
McPherson, Benjamin D., Blain, Pa. 1923
Mains, Guy B., Forest Service, Emmett, Idaho. 1921
Makibben, Charles Frederick, Box 62, Kooskia, Idaho. 1921
Maloy, Thomas P., City Forester, Park Dept., Rochester, N. Y. . 1923
Mandenberg, E. C., 366 Marshall St., East Lansing, Mich. 1919
Marckworth, Gordon Dotter, 201 Comstock Bldg., Columbus, Ohio 1921
Markwardt, Lorraine Joseph, 12 Lathrop St., Madison, Wis. 1923
Marshall, George Edward, Forest Service, Cass Lake, Minn. 1923
Mason, Earl George, School of Forestry, Oregon Agricultural College, Corvallis, Oreg. 1924
Matteson, DeForest Almeron, Allegheny State Park, Quaker Bridge, N. Y. 1923
Mattoon, Merwin Albert, Box 629, Asheville, N. C. 1923
Matz, Fred A., Forest Service, Portland, Oreg. 1921
Medley, James William, Forest Products Laboratory, Madison, Wis. 1923
Meloney, Henry Mitchell,* Robert R. Sizer & Co., 15 William St., New York, N. Y. 1924
Merkle, Fred, Forest Service, Snowflake, Ariz. 1921
Merriam, Lawrence Campbell, 736 Northwestern National Bank Bldg., Portland, Oreg. 1923
Merrill, Frederick Brettell, North Carolina Geological and Economic Survey, Raleigh, N. C. 1923
Merrill, Perry Henry, Forestry Dept., Montpelier, Vt. 1923
Metzger, Homer S., 341 Pine St., Williamsport, Pa. 1923
Meyer, Walter H., Northeastern Forest Experiment Station, Amherst, Mass. 1924
Millen, F. H., Pompton Lakes, N. J. 1919
Miller, Edward G., Forest Service, Flagstaff, Ariz. 1921
Miller, Edwin Burnett, 628 Swank Bldg., Johnstown, Pa. 1921
Miller, Fred High, Forest Service, Santa Fe, N. Mex. 1923
Miller, Harold Parsons, Pacific Lumber Co., Scotia, Calif. 1923
Moir, William Stuart, Box 611, St. Petersburg, Fla. 1921
Monell, George Roy, Gale St., Canaan, Vt. 1921
Morris, James, Dept. of Conservation, Boston, Mass. 1923
Morton, James Newton, Robertsdale, Pa. 1923
Munro, Robert, Forest Service, Prescott, Ariz. 1921

*Acceptance not received.

Members (Contd.) Date Elected

Murphy, Frank T.,* Pennsylvania State College, State College, Pa. 1924
Myer, J. E., Milford, Pa.... 1924
Myrick, Eldon Harland, Forest Service, Choteau, Mont.... 1923
Nagel, William M., Forest Service, Hamilton, Mont.... 1920
Naramore, David Copeland, 1308 Park Ave., Rochester, N. Y.... 1921
Neff, Philip, Missoula, Mont.... 1921
Nelson, Jesse Walker, Forest Service, San Francisco, Calif.... 1923
Newlin, John A., 2240 Keyes Ave., Madison, Wis.... 1921
Nicholas, Herbert Murray, Route 2, Fayetteville, Pa.... 1923
Nix, Leon Allen, Pembroke Lumber Co., Ltd., Pembroke, Ont., Canada 1923
O'Brien, George W., 829 Standard Bank Bldg., Vancouver, B. C. 1923
Oliver, Thomas Keyser, Hobart Estate Co., Hobart Mills, Calif.. 1923
Oppel, Arthur Frederick, 1523 Branston St., St. Paul, Minn.... 1921
Osborn, Minott Lowry, Box 57, Klamath Agency, Oreg.... 1923
Oteyza, Mauricio Julian,* Baguio, Philippine Islands.... 1924
Paine, Frederick Rodney, 606 Sellwood Bldg., Duluth, Minn.... 1921
Palmer, Lawrence John, U. S. Biological Survey, Nome, Alaska.. 1921
Parmenter, R. B., 21 Ellis St., Brockton, Mass.... 1922
Pearce, Wallace James, Forest Service, Steamboat Springs, Colo. 1921
Peck, Edward Coit, 2001 Monroe St., Madison, Wis.... 1921
Peck, Ray, Forest Service, Grand Junction, Colo.... 1921
Perry, Walter Julian, Forest Service, La Madera, N. Mex.... 1921
Peterson, Carl I., North Carolina Geological & Economic Survey, 33 Broadway, Asheville, N. C.... 1924
Peterson, Jesse L., Forest Service, Portland, Oreg.... 1922
Petheram, Harry Duane, Cass Lake, Minn.... 1923
Phillips, Henry Brubaker, 417 Eutaw St., New Cumberland, Pa. 1923
Phillips, Roy Albert, Forest Service, Sandpoint, Idaho.... 1921
Pierson, Albert Halsey, Forest Service, Washington, D. C.... 1923
Pierson, Henry B., Maine Forest Service, Augusta, Maine.... 1924
Pitchlynn, Paul P., Forest Service, San Francisco, Calif.... 1923
Plumb, Herbert Lansing, Forest Service, Bend, Oreg.... 1921
Pooler, Frank Clay Wisner, 115 S. 14th St., Albuquerque, N. Mex. 1921
Price, Jay Hamilton, 2528 Martinez Ave., Berkeley, Calif.... 1922
Proell, Albert Karl, Keene, N. H.... 1923

*Acceptance not received.

Members (Contd.) Date Elected

Pryse, Elias Morgan, Indian Service, Washington, D. C........ 1923
Pulling, Albert Van Siclen, University of New Brunswick, Fredericton, N. B.................................... 1922
Racelis, Antonio P., Bureau of Forestry, Manila, P. I.......... 1924
Radcliffe, Reginald Heber, Modoc Lumber Co., Aspgrove, Oreg. 1923
Radtke, Leonard Benjamin, Forest Service, Pioneerville, Idaho.. 1924
Rand, Ernest Abbott, 630 Prospect Ave., Rumford, Maine...... 1923
Raupach, Carl Valentine, 1587 Seventh St., Milwaukee, Wis..... 1923
Rendall, Raymond Eaton, Alfred House, Alfred, Maine........ 1921
Reynolds, Harris Aquilla, 4 Joy St., Boston, Mass............. 1923
Richards, Harry Elwood, Endeavor, Pa....................... 1923
Rider, William B., Deputy State Forester, Sacramento, Calif.... 1923
Riley, James E., Jr., 157 Main St., Montpelier, Vt............. 1921
Riley, Robert M., Forest Service, Sonora, Calif............... 1924
Roeser, Jacob, Jr., Federal Bldg., Colorado Springs, Colo....... 1921
Ross, Robert Murray, 14 Spring St., Montpelier, Vt........... 1921
Round, Harold Ford, Foresters Office, Pennsylvania R. R., Philadelphia, Pa. 1923
Rowland, Arthur Lindley, 4948 Emerson Ave. S., Minneapolis, Minn. 1923
Rowland, Horace Binney, Warren, Pa........................ 1923
Rupp, George Francis, Dept. of Forestry, State College, Pa..... 1923
Rush, William Marshall, Forest Service, Choteau, Mont........ 1923
Rutledge, R. H., Forest Service, Ogden, Utah................. 1920
Ryan, James Edward, Thompson Falls, Mont................. 1921
Ryan, John Francis, 64 Main St., Yonkers, N. Y.............. 1923
Salton, Robert Clark, Box 715, Alamogordo, N. Mex.......... 1921
Sammi, John C., Forest Service, Quincy, Calif................ 1924
Sanderson, Wilford E., Camp Mishike, Winchester, Wis........ 1923
Sanford, Burnett, Forest Service, Northfork, Calif............ 1921
Savage, Ernest Thompson, 15 State St., Bangor, Maine........ 1922
Saxton, Harry R., 865 N. Main St., Jamestown, N. Y.......... 1922
Schrader, Walter H., Forest Service, Monument, Colo......... 1921
Schreck, Robert Graham, Forest Service, East Tawas, Mich.... 1921
Schumacher, Francis Xavier, 305 Hilgard Hall, Berkeley, Calif.. 1923
Scovell, Earl L., Dept. of Conservation, Trenton, N. J.......... 1924
Secrest, Edmund, Ohio Agricultural Experiment Station, Wooster, Ohio... 1919

Members (Contd.) Date Elected

Shaw, Arnold Campbell, Forest Service, Knoxville, Tenn....... 1921
Shaw, Thomas Edward, State Forest Academy, Mont Alto, Pa. 1923
Shawhan, H. W., Jr., Box 163, Beckley, W. Va............... 1923
Shelley, Ralph Seymour, Forest Service, Portland, Oreg........ 1921
Shoemaker, David Arthur, Forest Service, Ogden, Utah........ 1921
Shoemaker, Theodore, Forest Service, Missoula, Mont.......... 1923
Sifferlen, Charles Edwin, 909 Comstock Ave., Syracuse, N. Y... 1921
Silva, Abbot Beecher, 6007 Euclid Ave., Cleveland, Ohio....... 1922
Simmons, Charles Wade, Forest Service, Santa Fe, N. Mex..... 1923
Slater, Charles Adolphus, Duncan Ave., Cornwall-on-Hudson, N. Y. 1923
Sloan, James M., 431 W. Broad St., Hazelton, Pa.............. 1923
Smith, Eastburn Richey, Camp 22, Bellemont, Ariz............ 1924
Smith, E. Emerson,* Mason, N. H.......................... 1924
Smith, Glen Albert, 1411 Jackson St., Missoula, Mont......... 1920
Smith, Homer A., 6 Center St., Pottsville, Pa................ 1923
Smith, Leland S., Forest Service, Alturas, Calif............... 1923
Smith, R. E., Kan. W. T. & B. Co., Pier 40, Seattle, Wash...... 1921
Smith, Reuben William, Jr., St. Helens, Oreg................. 1923
Snyder, Abraham F., Dushore, Pa.......................... 1923
Snyder, Thomas E., Bureau of Entomology, Washington, D. C.. 1919
Spaeth, John Nelson, Harvard Forester, Petersham, Mass...... 1922
Sproat, Will J., Forest Service, Republic, Wash............... 1921
Stadden, R. W., 618 Main St., Stroudsburg, Pa............... 1923
Stadtmiller, Louis Roemer, P. O. Box 457, Windsor, Conn...... 1923
Steffen, E. H., Dept. of Forestry, State College, Pullman, Wash. 1919
Stephens, Raymond Donnell, Lincoln Pulpwood Co., Box 923, Bangor, Maine 1923
Steuart, Charles, Ethelsville, Ala........................... 1921
Stevens, Clark L., University of New Hampshire, Durham, N. H. 1923
Stevens, Wingate Irving, 60 Washburn Ave., Portland, Maine.. 1923
Stewart, Gilbert Ireland, 305 Chamber of Commerce Bldg., Milwaukee, Wis. 1923
Stone, Bonnell Harold, Blairsville, Ga....................... 1923
Stone, Everett Bascom, Jr., Forest Service, Hot Springs, Ark.... 1923
Stoneburner, William Henry, 1237 Broad St., Bristol, Tenn..... 1921
Stott, Calvin Brill, 94 Prospect St., New Haven, Conn.......... 1923
Strickland, Simeon, P. O. Box 144, Alamogordo, N. Mex...... 1921

*Acceptance not received.

Members (Contd.) Date Elected

Stubbs, Robert G., Augusta, Maine.......................... 1919
Studley, James Donald, 3929 Angeline St., Seattle, Wash....... 1921
Sutton, Claude Earl, 16 N. Bosart Ave., Indianapolis, Ind...... 1920
Swales, Robert Davis, Union Lumber Co., Fort Bragg, Calif..... 1923
Swartz, Ulysses Simpson, Forest Service, Ogden, Utah........ 1920
Sweeney, Samuel C., W. Virginia Pulp & Paper Co., 200 Fifth Ave., New York, N. Y.............................. 1924
Swenning, Karl Alphonse, Mead Pulp & Paper Co., Chillicothe, Ohio 1923
Swim, Clarence Burton, Box 140, Bozeman, Mont............. 1921
Taber, William S., Dept. of Forests and Waters, Harrisburg, Pa. 1923
Tanner, Earl B., Timber Section, Bureau of Internal Revenue, Washington, D. C.................................... 1921
Tarbox, Errol E., 307 Main St., Sanford, Maine............. 1924
Taylor, George Rodney, 135 Jefferson Ave., Scranton, Pa....... 1923
Taylor, Thornton Greenwood, Forest Service, Heise, Idaho..... 1923
Telford, C. J., 504 N. Romine St., Urbana, Ill................ 1923
Ten Eick, Charles Watson, 410 Cathedral Parkway, New York, N. Y. 1921
Terhune, Lawrence Edward, Box 63, New Gretna, N. J........ 1923
Thelen, Rolf., 2212 Rowley Ave., Madison, Wis.............. 1921
Tilley, Walker B., Albion Lumber Co., Navarro, Calif......... 1923
Tobey, Frank Lindley, Forest Service, Butte, Mont............ 1923
Tryon, Henry B., Box 529, Aiken, S. C...................... 1919
Turner, Harry C., Forest Service, Halsey, Nebr............... 1919
Van Orsdel, John Pomeroy, 505 Lowman Bldg., Seattle, Wash.. 1923
Vaux, Cleland Hager, 1624 College St., Columbia, S. C......... 1923
Voight, Alfred W., Forest Service, Springerville, Ariz.......... 1919
Volkert, Robert Morris, Forest Products Laboratory, Madison, Wis. 1923
Wackerman, Albert Edward, Lake States Forest Experiment Station, University Farm, St. Paul, Minn................... 1923
Wagener, Willis Westlake, Forest Service, San Francisco, Calif. 1922
Wahlenburg, William Gustavus, Forest Service, Haugan, Mont.. 1921
Walley, James Merrill, Forest Service, Ketchikan, Alaska....... 1923
Wasilik, John, Jr., Forest Service, Franklin, N. C.............. 1923

Members (Contd.) Date Elected

Watkins, William Morgan Neiger, U. S. National Museum, Washington, D. C. 1923
Watson, Clarence Wilford, Route 1, Woodbridge, Conn. 1921
Watson, Myron E., Forestry Specialist, State of Maine, Orono, Maine 1924
Webb, Clyde Stephen, 302 Garden Ave., Coeur d'Alene, Idaho . . . 1921
Weber, Henry Goessler, 309 10th St., S., Virginia, Minn. 1921
Webster, Cyril Bertram, Forest Service, Colorado Springs, Colo. 1921
Wells, Sidney Deeds, Route 3, Madison, Wis. 1921
Wendover, R. F., Bureau of Forestry, Manila, P. I. 1924
Weston, John Roland, 1201 Gasco Bldg., Portland, Oreg. 1923
Wheeler, Herbert Newell, Forest Service, Denver, Colo. 1921
Wheeler, William Crawford, 31 Central St., Bangor, Maine. . . . 1922
White, Wellington Irwin, Forest Service, Livingston, Mont. 1921
White, William Emby, New Port Richey, Fla. 1923
Whitney, Alvin Goodnow, New York State College of Forestry, Syracuse, N. Y. 1923
Whitney, Chester Nathan, Forest Service, Missoula, Mont. 1920
Whitney, Raymond Lee, Bingham, Maine. 1923
Wickenden, Henri Robert, 73 St. Francis Xavier St., Three Rivers, P. Q. 1922
Wiggin, Gilbert Henry, Tower, Minn. 1921
Wilcox, Arthur Roys, Forest Service, Eugene, Oreg. 1921
Wilcox, Herbert Fisk, Forest Service, Greenville, Calif. 1921
Williams, Arthur Ross, New York State College of Forestry, Wanakena, N. Y. 1924
Williams, William Kinsey, Jr., Crossett, Ark. 1923
Wilson, Frederick G., Box 742, Rhinelander, Wis. 1923
Wilson, Stanley Fosdick, Taos, N. Mex. 1921
Wilson, Thomas Randall Carson, Forest Products Laboratory, Madison, Wis. 1921
Winn, Frederic, 826 Eighth St., Silver City, N. Mex. 1921
Wise, Lloyd Wilbur, Pelham Court, Pelham, N. Y. 1921
Wohlen, Paul A., Forest Service, Orofino, Idaho. 1923
Wolfe, Kenneth, Forest Service, Kalispell, Mont. 1921
Wood, Arthur P., 3238 Chestnut St., Philadelphia, Pa. 1921
Woodhead, Phillip Verne, Box 914, Sheridan, Wyo. 1923
Woodman, J. E., Bennington, Vt. 1924

Members (Contd.) Date Elected

Wright, Wm. E.,* Jas. D. Lacey & Co., 10 Woodbine Ave., New Rochelle, N. Y. 1924
Wulff, Johannes, Division of Forestry, Nashville, Tenn. 1923
Zerby, Charles E., 58 N. Fifth Ave., Clarion, Pa. 1923
Zeller, Robert Allen, Forest Service, Ketchikan, Alaska 1921
Zilevitz, Reuben Robert, Chateaugay Ore & Iron Co., Plattsburg, N. Y. 1923
Zschokke, Theodore C.,* Asst. Forester of Hawaii, Honolulu, Hawaii 1924

Associate Members

Adams, Charles C., New York State College of Forestry, Syracuse, N. Y. 1916
Adams, Ralph Beers, 437 Eddy Ave., Missoula, Mont. 1921
Allen, Grenville F., Forest Service, Tacoma, Wash. 1916
Barber, John R., 502 W. Roosevelt St., Phoenix, Ariz. 1914
Bazeley, William Alliston Lay, 519 State House, Boston, Mass. 1921
Betts, Harold Schofield, Forest Service, Washington, D. C. 1908
Blair, Roy Jay, 700 University St., Montreal, Canada 1921
Bonner, Frank E., Forest Service, San Francisco, Calif. 1914
Britton, Nathaniel Lord, New York Botanical Garden, Bronx Park, New York, N. Y. 1915
Brown, William R., Brown Co., Berlin, N. H. 1921
Burgess, Albert Franklin, 43 Tremont St., Boston, Mass. 1915
Burns, George P., University of Vermont, Burlington, Vt. 1914
Carpenter, Warwick S., Conservation Commission, Albany, N. Y. 1919
Clements, Frederick Edward, 530 E. First St. Tucson, Ariz. 1913
Colby, Forrest Henry, 120 Exchange St., Portland, Maine 1921
Cooper, Lee E., Forest Service, Pinedale, Wyo. 1916
Coville, Frederick Vernon, Bureau of Plant Industry, Washington, D. C. 1900
Cowles, Henry C., University of Chicago, Chicago, Ill. 1915
Craft, Quincy R., Forest Service, Albuquerque, N. Mex. 1919
Craig, Horace Jackson, Bingham, Maine 1923
Dayton, William A., Forest Service, Washington, D. C. 1919
Douglas, L. H., Forest Service, Denver, Colo. 1915
Fenn, Frank A., 419 Eddy Ave., Missoula, Mont. 1908

*Acceptance not received.

Associate Members (Contd.)	Date Elected
Fenn, Homer E., Ogden, Utah	1918
Fowler, Frederick Hall, Forest Service, San Francisco, Calif	1920
French, Harry H., Forest Service, Glenwood Springs, Colo	1916
Fuertes, Louis Agassiz, Cornell Heights, Ithaca, N. Y	1919
Gerry, Eloise, 419 Sterling Place, Madison, Wis	1923
Green, Thornton A., Ontonagon, Mich	1919
Hardtner, Henry E., Urania, La	1918
Harper, Roland M., University, Ala	1915
Harris, John Tyre, Kedrick Apartment, Washington, D. C	1919
Hensel, Rudolph Louis, Kansas Agricultural College, Manhattan, Kans.	1921
Herty, Charles Holmes, University of North Carolina, Chapel Hill, N. C	1905
Hutchins, Frank Benjamin, 711 Consolidated Bldg., Los Angeles, Calif.	1923
Hutchins, Maxwell Cressey, 513 State House, Boston, Mass	1922
Ingalsbe, Frank Richmond, 422 Rollins St., Missoula, Mont	1921
Jepson, Willis Linn, University of California, Berkeley, Calif	1919
Johnson, Bolling Arthur, Lumber World Review, 608 S. Dearborn St., Chicago, Ill	1919
Johnson, Charles Russell, Union Lumber Co., Crocker Bldg., San Francisco, Calif	1923
Lewis, Joseph Graham, Route K, Box 172, Fresno, Calif	1923
Lowell, John W., Cody, Wyo	1921
Mackenzie, Thomas P., Forest Branch, Victoria, B. C	1918
Merriam, C. Hart (Dr.), 1919 16th St., N. W., Washington, D. C.	1902
Merrill, Oscar C., Federal Water Power Commission, Washington, D. C	1916
Metcalf, Haven (Dr.), Bureau of Plant Industry, Washington, D. C.	1911
Miller, John M., Northfork, Calif	1911
Mowry, Jesse Benton, Chepachet, R. I	1923
Myers, George Hewitt, 2310 S St., N. W., Washington, D. C	1914
Nelson, Edward William, U. S. Biological Survey, Washington, D. C.	1915
Nelson, Jesse W., Forest Service, San Francisco, Calif	1916
Nichols, George Elwood, 439 Edgewood Ave., New Haven, Conn.	1923
Norcross, Theodore W., Forest Service, Washington, D. C	1916
Oxholm, Axel H., Bureau of Foreign and Domestic Commerce, Washington, D. C	1923

Associate Members (Contd.) Date Elected

Palmer, Theodore S., 1939 Biltmore St., N. W., Washington, D. C. 1915
Pammel, Lewis Hermann, Iowa State College, Ames, Iowa...... 1915
Pardee, George C., 672 Eleventh St., Oakland, Calif........... 1923
Pool, Raymond J., University of Nebraska, Lincoln, Nebr...... 1916
Pratt, George D., Conservation Commission, Albany, N. Y...... 1916
Pratt, Joseph Hyde, Asheville, N. C........................ 1923
Ridsdale, Percival Sheldon, American Tree Assn., Washington, D. C. 1915
Rolle, August H. O., Bureau of the Census, Washington, D. C... 1924
Shaw, Ernest W., Forest Service, Livingston, Mont............ 1916
Shoemaker, Col. Henry W., McElhattan, Pa................. 1924
Shreve, Forrest, Desert Laboratory, Tucson, Ariz.............. 1915
Slattery, Harry A., Woodward Bldg., Washington, D. C....... 1921
Smith, Franklin H., U. S. Tariff Commission, Washington, D. C. 1919
Speh, Carl F., 618 Audubon Bldg., New Orleans, La........... 1919
Thompson, John Lewis, Box 143, Houston, Texas............. 1922
Violette, Neil Louis, State House, Augusta, Maine............ 1922
Waugh, Frank Albert, Massachusetts Agricultural College, Amherst, Mass. 1922
Webb, William S. (Dr.), Shelburne, Vt...................... 1901
Weir, James R. (Dr.), Bureau of Plant Industry, Washington, D. C. 1914
Wells, Philip P., P. O. Box 1005, Middletown, Conn........... 1908
Whipple, James S., Department of Excise, Albany, N. Y....... 1915
Wiley, Clarence, Federal Bldg., Santa Barbara, Calif 1920
Williams, Irvin Cooke, State Normal School, Slippery Rock, Pa. 1918
Williams, Solon Heywood, 711 Forum Bldg., Sacramento, Calif.. 1923
Woodruff, George, 1218 Real Estate Trust Bldg., Philadelphia, Pa. 1905
Woods, Clarence N., Forest Service, Ogden, Utah............. 1918
Zimmerman, Conrad W., Box 112, University Station, Seattle, Wash. 1919

Honorary Members

Antoni, Paul., Inspector General des Eaux et Forets, 1 Rue de Narbonne, Paris, France.............................. 1921
Bowers, E. A. (Prof.), 258 St. Ronan St., New Haven, Conn.. 1914
Clutterbuck, P. H., Inspecor General of Forests, Simla, India... 1910

Honorary Members (Contd.) Date Elected

Francis, David R. (Hon.), St. Louis, Mo.................... 1914

Lovat, General Lord, Forestry Commission, 22 Grosvenor Gardens, London, S. W., England.......................... 1921

Newell, Frederick H., 1706 21st St., N. W., Washington, D. C... 1914

Sargent, Charles Sprague (Prof.), Jamaica Plain, Mass........ 1914

Sutherland, Col. John, Forestry Commission, 25 Drumsheugh Gardens, Edinburgh, Scotland......................... 1921

Walcott, Charles D., (Hon.) Smithsonian Institute, Washington, D. C. 1914

Corresponding Members

Joubaire, Lt. Col. Armand, Conservateur des Eaux et Forets, Tours, France 1921

Leete, F. A., Chief Conservator of Forests, Rangoon, Burma, India 1921

Smitt, Anton, Fylkeskogmester, Stavanger, Norway........... 1921

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art. = article; rev. = review; ref. = reference (current literature); br. = brief (periodical literature); n. = note.

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